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TABLE OF CONTENTS

Page

LEADING ARTICLES:

Mines and Aerial Tramways of the U. S. Mining Co., at Bingham, Utah (illustrated). W. P. Hardesty, C E. 121

Some Notes on a Recent Elevator Accident (illustrated). Chas. R. Pratt, M. Am. Soc. M. E. 124

Special Reports on Typhoid Fever and Water Supply 125

The Great Fire at Baltimore, Md. 127

Effect of Fire in an Office (illustrated) 134

The Typhoid Fever Epidemic at Columbus, Ohio (illustrated). F. H. Eno, M. Am. Soc. C. E. 134

Sewage Purification Made Compulsory by the Minnesota State Board of Health. H. M. Bracken, M. D. 138

A Bottom-Dumping Concrete Bucket (illustrated) 138

New Shops of the Chicago, Rock Island & Pacific Ry. at East Moline, Ill. (illustrated) 138

Present Day Costs of Transportation by Rail and by Water. K. W. Blackwell, President Am. Soc. C. E. 143

A Pioneer in the Heat Treatment of Steel (with portrait) 144

ENGINEERING NEWS OF THE WEEK 127

EDITORIAL COMMENT.—The Conflagration Hazard in Large Cities——Water Curtains as a Protection Against Exposure Fires——A Drastic Rule for Sewage Purification by Minnesota Towns and Cities——The First Meeting of the Sanitary Section of the Boston Society of Civil Engineers——The Growth of Trade with Canada and Mexico——A Railway Engineering School at McGill University——Some Curious Accident Statistics of English and American Railways 128

EDITORIAL.—The Unusual Prevalence of Typhoid Fever in 1903 and 1904 129

LETTERS TO THE EDITOR.—Another Low-Priced Engineer Wanted: H. S. M. ——A Method of Thawing Dynamite: Shirley C. Hulse, Jun. Am. Soc. C. E. ——A Simple Formula for Reinforced Concrete Beams: Frank L. Batchelder, C. E.——Some Questions Relating to the Design of Overtopped Masonry Dams (illustrated): John C. Trautwine 3d——The Attitude of Engineers Toward Water Meters: Freeman C. Coffin, M. Am. Soc. C. E.——How May Capital Be Safely Invested in New Inventions? Chas. R. Pratt——Data on the Shrinkage of Macadam Under the Roller: H. K. Barrows, Assoc. M. Am. Soc. C. E.——San Francisco Opinions on the Union Engineering Building: Chas. D. Marx——Opinions of Washington Members of the American Society of Civil Engineers Respecting the Union Engineering Building: Herbert M. Wilson——A Division of the Carnegie Gift Suggested: John A. Fulton, M. Am. Soc. C. E.——Reasons Against the Proposed Co-operation: W. H. Breithaupt——Who Would Manage the Building? "T. H. L."——The Union Engineering Building: Alexander Potter, Assoc. M. Am. Soc. C. E. ——A Negative Vote and the Reputation of the Engineering Profession: George W. Colles——The Business Aspect of the Union Engineering Building: S. Whinery——Notes and Queries 130-134

MINES AND AERIAL TRAMWAYS OF THE U. S. MINING CO., AT BINGHAM, UTAH.

By W. P. Hardesty, C. E.*

The consolidation of the various departments of industry having to do with the manufacture or production of many of the commodities of life during the past few years has extended to the production of the precious metals as well as to other fields. The consolidation of mining properties themselves has also become quite common. A good illustration of this tendency is shown in the United States Mining Co., at and near Bingham, Utah, about 25 miles southwesterly from Salt Lake City. The West Mountain Mining District (the mines in which are generally referred to as being in the Bingham camp) takes in all the eastern slope of the Oquirrh Range of mountains in this locality.

Bingham Canyon extends in a general northeasterly direction through the central part of the camp for seven miles, from near the summit of the range to where it debouches into the Salt Lake Valley. A number of deep side-gulches enter the canyon. Elevations range from 5,500 to 9,200 ft. above sea-level.

The first discovery of the precious metals in Utah was made in 1863 by soldiers of General Connor's army, a rich silver-lead ore being found. The first location was made on Sept. 17, 1863. This, the Old Jordan claim (U. S. lot, No. 64, Fig. 2), was made 5,200 ft. long. The ore was assayed and gave a return of silver of 71 oz.; lead,

SURFACE WORKS OF THE UNITED STATES GOLD MINES AT BINGHAM, UTAH.

(Old Jordan Mine in middle background. Buildings of Old Telegraph Mine in lower left-hand corner. Upper tramway line shows very faintly at right of main gulch.)

*Salt Lake City, Utah.

56 oz., and gold, 11 pennyweights per ton. The Old Jordan is the oldest mine in the district.

The Old Telegraph mine was afterward opened up, and during the seventies the Old Telegraph properties were sold to a French syndicate for $3,000,000. The Niagara mine was still later developed, and in April, 1899, the three properties mentioned were sold to the United States Mining Company for over $2,000,000. This company was formed for the purpose of consolidating the properties and working them according to a comprehensive plan.

The total production of the three properties prior to the sale is estimated at nearly $30,000,000, of which Old Jordan supplied almost one-half. The U. S. Co. did not begin a systematic extraction of the ores until January 1, 1903, but in the interim it spent large sums of money in retimbering tunnels, blocking out ore bodies, and in development generally. Besides development and repairs underground, all the surface improvements were overhauled and the plants put in first-class condition.

GEOLOGICAL FORMATION.—The geological formation at Bingham is very complex, and the existence and location of the main ore bodies were not well comprehended by the earlier miners. It has been found that there is a mineral zone extending across the camp in a general easterly and westerly direction, that contains most of the valuable ore so far found. The principal lode of this zone, the Jordan, has an average thickness of about 150 ft. It dips (Fig. 2) in a general northerly direction, and the width of its outcrop mostly depends on the slope of the ground relative to it. Where the two run nearly parallel, the outcrop is quite broad, being in places from 500 to 700 ft. in width. The lode consists of limestone, with deposits of ore of varying thickness running through it. The formation on each side is of quartzite. The limestone is pregnant with ore bodies found in connection with an altered lime or chert of irregular shape and dimensions. Porphyry is found in places, and near the contact with the quartzite detached masses of the latter are often found. The ore, consisting usually of the sulphides of silver, lead and copper (with good values in gold) is found in the beds all through the limestone. In many places the entire depth of the lode is taken by the ore, and in the development of the entire mine, merchantable ore has been found on one or more of the different levels continuously for a distance of 4,700 ft. along the strike of the lode.

In the early days the mining was confined to the carbonate ores found at and near the surface, overlying the sulphides. Not much work was done below about 50 ft. below the surface; in fact, very much of the ore was shoveled from open cuts and pits directly onto wagons without the necessity of even tram-cars. During later years, as increasing depth has been attained, the geological formation and the occurrence of ores have become much better understood. The sulphides formerly were not desirable, on account of the high price of smelting them, but improved processes have overcome this. Most important of all has been the discovery that immense bodies of copper ore lie under the other ore bodies. The copper is, indeed, found at the surface, but it becomes more conspicuous as depth is attained, until finally it is the most important metal. The improved processes of smelting the copper ores found here, together with the greatly increased demand for the metal of late years that has arisen from its extensive use in electrical appliances and long-distance transmission lines, have lately made it about the most important product of the camp. Most of the mining has been done through tunnels. Most of the ore bodies can be reached through comparatively short tunnels, on account of the deep canyons and gulches and steep slopes of the mountains.

MINING THE ORE.—In the Jordan mine the old tunnels were retimbered and good tramway tracks laid. These tunnels were extended and drifts run so as to block out enormous quantities of ore. This is now being stoped out. The ore is excavated by overhand stoping, and square sets of timbers are added as fast as needed to support the roof. A set is made of 8 × 8-in. sawed timbers, and is 5 ft. 7 ins. inside dimensions. The caps are 7½ ft. apart vertically, c. to c. As in the intermediate sets, the ends of six timbers have to be joined together, good framing and fitting are required. The ore beds in places are so thick that the face of the stoping is 30 to 40 ft. high, requiring several sets of timbers before the hanging wall is reached. Drilling is mostly done by air drills, mounted on columns, the blasted ore falling on a temporary platform made of lagging material, placed on the caps of the top set. The ore and waste are assorted underground. The greater weight and softer nature of the ore bodies require closer timbering than for the country rock, so that when the hanging wall is reached the timbering is not so important. In some cases tunnels driven to develop certain parts of the mine were located in the footwall quartzite, some distance below the ore body, in order to avoid the expensive timbering required to support it if driven along the footwall. Whenever the roof of the tunnel came near or cut into the ore, on account of the waves in the lode, the great weight to support at once became apparent. In many places good ore is continuous from hanging to foot-wall. The tunnel levels are usually 50 to 100 ft. apart vertically. Where the ore is not continuous, raises are run from the lower level to the next above. Each raise is timbered and has two compartments, a manway and an ore-chute. The ore is emptied directly from a chute into a tram-car in a tunnel or drift on the lower level.

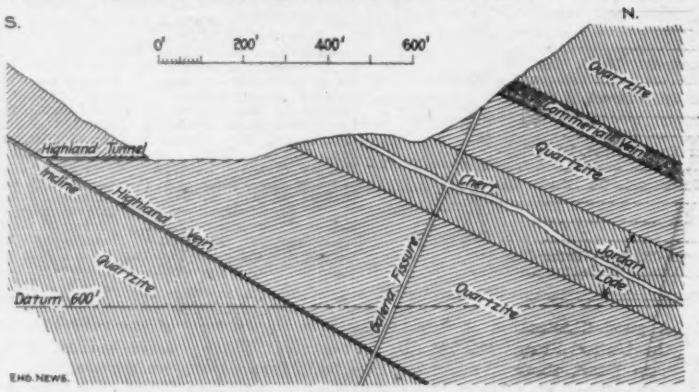


FIG. 2. SECTION ALONG THE EAST END LINE OF JORDAN CLAIM (U. S. LOT 64).

The main tunnels are lighted by electricity. The pipes for compressed air are run through them, being supported on one side near the roof. The tramways are 18-in. gage, laid with 16-lb. rails on a grade of usually 1%. The track is kept in good condition, as is necessary with the extremely heavy train loads. The cars are gab[le] bottom (dumping by the sides swinging out from a bottom), of four tons capacity each, and weighing about one ton each. The ore is put in trains of three to four cars. The latter number gives a gross load of 20 tons, and it requires a [mule]-class 1,400-lb. horse to haul it out. The waste is hauled to a dump, while the ore is hauled out over a trestle to the loading terminal of the aerial tramway.

At the present time the U. S. Mining Co. owns 79 patented claims containing 348 acres, and also 46 locations (many of which have been surveyed for patent) containing not less than 200 acres additional. The property extends in an unbroken body for a distance of nearly two miles easterly and westerly. Not less than 35 miles in tunnel-levels, drifts, cross-cuts, shafts, etc., have been cut since the mines were opened.

The Old Jordan mine is situated well toward the head of the main Bingham canyon, while the Telegraph is located in Bear Gulch, shortly above its junction with the canyon. The Niagara is located between the other two.

AERIAL TRAMWAYS.—After mining the ores, an important part of the company's undertaking is to get them to the railroad, to be shipped to the smelter. Freighting with wagons was the old-time method of doing this, and in ores that were not high-grade it formed an important item of cost. Horse tramways have also been much used at Bingham, but during the past three years these have been replaced by steam roads or aerial tramways. The Highland Boy tramway was the first to be built (see Eng. News, July 24, 1902), and it has proved very successful. The U. S. Co. also adopted this method of ore-hauling. The line built by it is heavier and of greater capacity than any heretofore built in the world, and has many interesting features. It is one of the latest of the many wire rope tramways that of late years have become fairly numerous.

The tramway is for conveying ore from the mines to the R. G. W. Ry. terminus at Bingham station. The Copper Belt R. R. (Eng. News, July 24, 1902), follows up the main canon to near the junction with Bear gulch, but this has grades as steep as 7.4%, which renders operation very costly; besides which grades much steeper than even this would be required for reaching the mines.

The tramway is of the Bleichert system and really consists of two distinct lines, the upper one reaching from the Old Jordan mine to near the mouth of the Evans tunnel, at the junction of the gulches. The ore from the Telegraph mine is hauled on a horse tramway for 1,000 ft. along the side of the mountain to a point opposite the terminal of this line, where the cars are run down an inclined cable tramway to the ore bins. The station here is called the discharge terminal for the upper line and the loading terminal for the lower or main line. In reality the buckets coming in over the upper line are not emptied, but are switched over on to the main line, the deflection of the course being about 65° to the left.

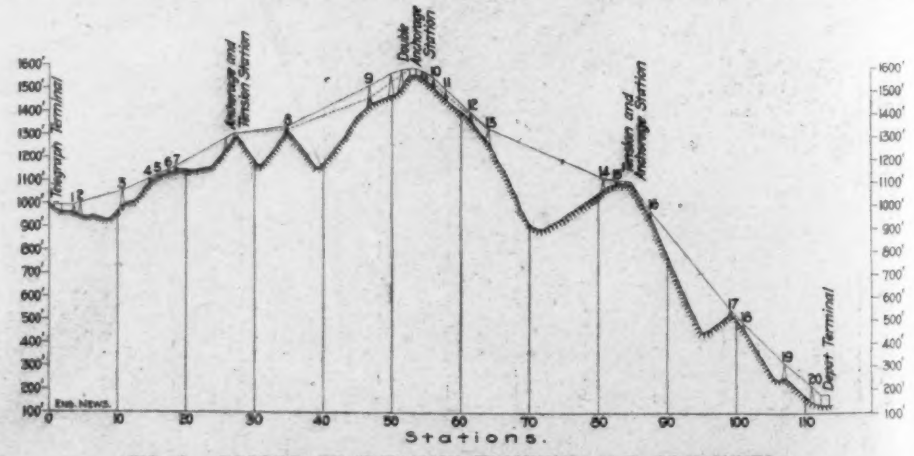


FIG. 3. PROFILE OF THE MAIN TRAMWAY, U. S. CO.'S MINES.
(The broken-line indicates the track cable as originally installed; the full line above, as now installed.)

THE MAIN TRAMWAY.—The general construction of the main tramway (or lower line) and

of the upper line are the same. The line runs a little west of north, and has a horizontal length of 11,160 ft. and an actual length of about 11,400 ft. There is a net fall of 815 ft. between terminals, though the range in elevation is about 1,400 ft., as shown in the profile, Fig. 3.

The track cables are divided into four divisions, ranging from ½-mile to 3,000 ft. The loading terminal is a tension station; next follows an anchorage-tension station, then a double-anchorage station (at the highest point on the line), next a tension-anchorage station, while the discharge terminal is a tension station. The two track cables are spaced 8 ft. apart. The one on the loaded side is 1⅝ ins. diameter, that on the empty side being 1 in. The tensile strength of these cables is said to be 120,000 lbs. per sq. in., while their working tension is intended not to exceed 30,000 lbs. The weights are 4.5 and 2.4 lbs. per ft., respectively. The track cable is the "patent locked-coil cable," in which the outer wires are so formed as to make a smooth surface for the bucket-carriages to run upon. This is probably the best design for overcoming the serious defect in an ordinary cable when used for a tramway, because of the carriage wheels rapidly wearing the strands forming the corrugated surface. The traction cable or rope is ⅞-in. diameter, and is of the ordinary kind.

The cables are supported by towers, Figs. 3 and 5, usually located on the high points or ridges crossed by the line. The spacing varies from about 100 ft. to 1,670 ft. On the span of 1,670 ft., the track cables reach a maximum height of 340 ft. above the ground.

The towers, Fig. 4, are of Oregon fir. The 8 × 8-in. pieces forming the six posts are spliced so as to form continuous lines, and they are thoroughly braced by horizontals and diagonals. The towers are wedge-shaped, the batter transversely to the line being but 1 to 12, while in the other direction it is 1 to 5. Thus the transverse distance between posts at the cap is 13 ft., while the center and two batter bents are all spliced together at their vertex. Foundations were prepared by making a sufficient excavation to bed short mudsills under each post for the main sill to rest on. As the line runs along the sloping side of the mountains, the posts are of different lengths, and special constructions, fitted to each case as it arose, were used to bring the structure up to the first horizontal belt of tie braces.

On the sills were placed heavy plank, on which were piled earth and stone to weight down the structure so as to prevent it being thrown over when subjected to wind pressure or the pull of the track cables. At some places, where the tower had to be founded on the bare solid rock, shallow cavities were blasted out and then brought up to an even bearing by a bed of cement; a hole was also drilled into the rock and a bolt (with slotted end spread by a wedge) was placed in this and the remaining space filled with melted sulphur. The bolt came through the short mud-sill, and its upper part (forged into a strap) was bolted to the post. This served in place of the weighting down.

Just under the cap or topmost crosspiece of the tower are the two saddle supports for the track cables. These are bolted to an upright frame built in the center of the tower. Each end of the supports carries a cast-iron saddle, in a slot of which the track cable rests. The cables are 8 ft. apart. The saddle supports are of yellow pine, with oak substituted where the pressure is very great. They are 4 × 10 ins. With the heavy weights of live and dead loads on this line, it is found that wood is unsatisfactory for the supports. Particularly is this the case at the sharp summits, where they have to carry not only one-half the weight of cable and loads for the adjacent spans, but the vertical component of the initial tension in the cables. Some of the arm-ends have crushed, and others have broken off. To remedy this, an iron hanger has been used, reaching from the double cap above down to one end of the saddle supports, thus transferring most of the strain on the latter. These were added for the entire length of the loaded side, and for the empty side in places. In a number of places the wooden arms have been taken off and built-up steel members substituted. Each steel support consists of a ⅜ × 10-in. plate and two 5 × 3½ × ⅜-in. angles. The two give a bearing surface 7¾ ins. wide. On these, and spanning the 8-in. space taken by the posts to which they are bolted, rest the saddles.

The channels in which the cables rest are kept oiled, as are the cables themselves, so that the latter move back and forth with but little friction under the varying tension.

Nine feet below the saddle supports are placed the roller supports, on which are placed the rollers on which the traction cable runs. They are placed vertically under the saddles, so that the traction cable runs 7 ft. below the main one. The bearings of these rollers are kept well oiled by an attendant who travels over the line in the buckets, getting off at the different towers.

Both the track and traction cables were stretched in laying by a team of horses. The former came on spools in sections about 1,200 ft. long. These sections were joined by means of couplings. A coupling is in halves, each hollow and shaped like the frustum of a cone. An end of the cable is run through one of these parts from the small end, and after the ends of the wire are spread, the intervening spaces are filled with small wedges, which are driven in tightly. The halves are then joined by a union with right and left screw-threads. A pull on the cable then, of course, tends to bind the wedges all the tighter, while their confinement within the coupling prevents their working loose. Sections of the traction cables are united by splicing. The ends are each unraveled for about 20 ft. and one-half of the wires are cut out. The splice is then made, leaving no projections.

Since the line was built a number of changes have been made. As shown on the profile, Fig. 4, there were some very abrupt changes of grade in the cable originally. The bucket carriages wore the cable at these places very rapidly. There was, moreover, at the sharp summits, a much greater additional pressure put upon the buckets by reason of the heavy pull on the traction cable at such points, both from its own tension and weight and from the heavy pull on it of attached buckets on each slope from the summit. The vertical component of this tension becomes quite large. There was also a severe strain on the grip of the buckets at these points, as when at the exact summit the traction cable, descending in either direction, made a large angle with the horizontal position of the jaws of the grip, often breaking them off. The summit at such places is made sharper by the traction cable being lifted about 5 ft. above its roller supports by the bucket during its passage.

Several high towers have been added at and near the main summit, and others have been put in at other points, as shown on the profile. These serve to ease the vertical curves. Besides those shown on the profile, some minor changes were made at and near the high summit north of the main summit, but these were not considered essential.

A plan that is often used to avoid undue wear on the track cables on sharp summits is that of inserting structures known as "rail stations." One consists of bents forming a trestle, on which are rails which form the tramway for carrying the bucket-carriages over from one slope to the other. The carriages run from the cables off on to the rails, which are just overhead the cables. But one of these stations is used on the main line here described, being a 3-bent one on the main summit.

Each section of track cable is anchored at one end and has a tension weight at the other. A tension of 18 to 20 tons is aimed at for the loaded cable, that on the empty side being less. The tension weights consist of strong boxes filled with ore, attached by a chain to the end of the cable. They are located beneath the floors of the tension station, the chain passing over a sheave and down to them. A bucket-carriage, on arriving at a station, passes from the cable onto a shunt rail, while the cable continues in an inclined direction down to a connection with its tension weight or anchorage.

The tension stations at the terminals provide for the pull by means of strong timber bracing

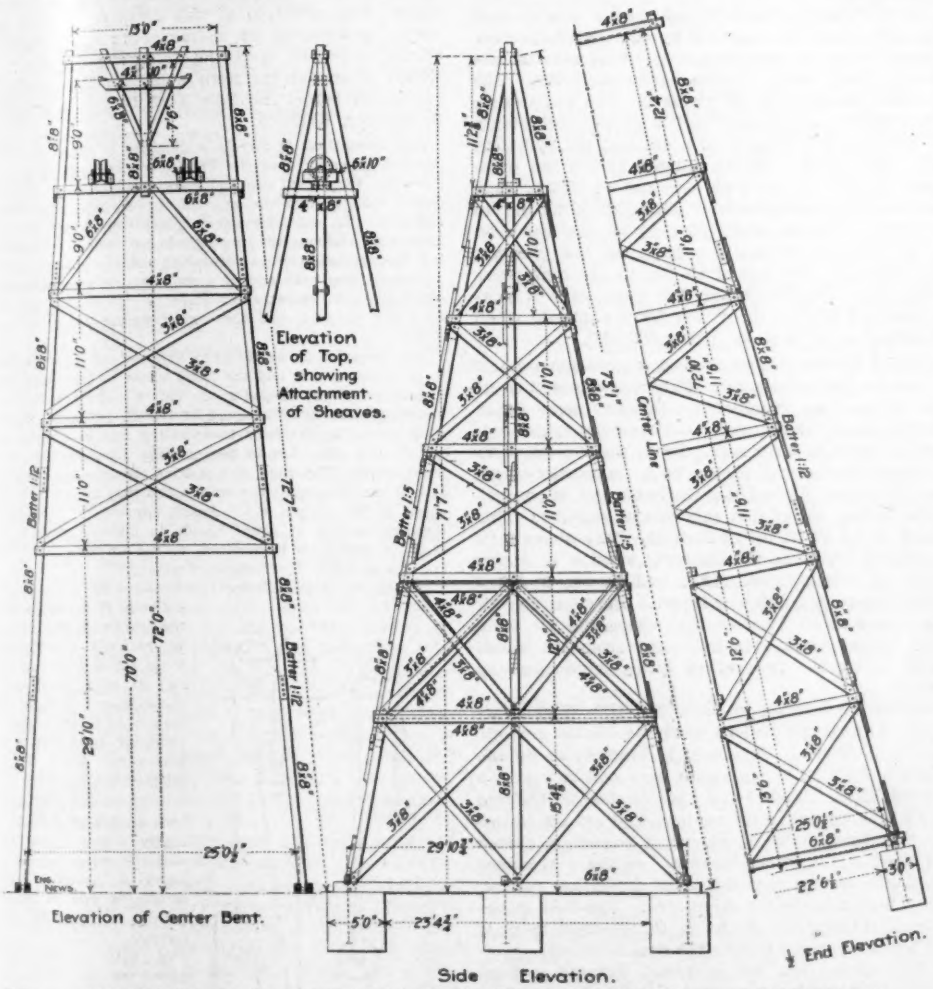


FIG. 4. ELEVATIONS OF BENTS OF TOWER NO. 20, MAIN TRAMWAY, U. S. CO.'S MINES.

under the main floor, the weight of the entire building being utilized. At the intermediate stations the pulls in opposite directions are made to nearly balance each other by rigid connections of the framework. The gaps in the cable tramway at these stations are filled in by iron rails, similar to those at rail stations.

The buckets for transporting the ore are unusually large, having a capacity of 9 cu. ft. With the ore ordinarily shipped this means a load of 1,600 to 1,800 lbs. The buckets are equipped with the Webber patent compression grip. These grips can be operated by hand or by automatic attachers and detachers. The normal speed fixed for operation is 333⅓ ft. per min., so that with buckets running at one-minute intervals, the line has a capacity of about 50 tons per hour.

At the upper terminal the traction cable makes two turns around a bull-wheel, by which friction enough is secured to allow of control of the cable by either automatic regulator or by hand-brakes connected with the wheel. The hydraulic automatic speed regulator supplies the braking power by consuming the power developed on the tramway in causing it to operate a rotary pump at very low speed, the resistance to the pump being that offered by a very small aperture to the forcing of oil through it. A governor on the regulator (belt-connected in the ordinary way) changes the size of the aperture and thus regulates the resistance and speed. Two band-brakes can be used for hand-regulation when desired. At the terminal of the upper line but one hand-brake is required. When the lines were first put in operation, a 10-HP. hydraulic regulator was installed for the upper line and a 20-HP. one for the lower line. But these were found to be too light, so the 20-HP. machine was transferred to the upper line and a 50-HP. was secured for the lower line. To start up the traction cable when the line is stripped of buckets, or there is not the right preponderance of weight on the loaded side, power is supplied to the bull-wheel from a horizontal shaft belt-connected to a shaft in the room below. A large cog-wheel on the bull-wheel shaft is moved by a pinion on the horizontal shaft, both being beveled. The latter is also belt-connected to the regulator.

The tramway cars loaded with ore from the mines are run on elevated tracks into the upper stories of the loading terminals and emptied into ore bins. The buckets are loaded through chutes from these bins. Each loaded bucket is then run forward by an attendant to the automatic attacher, consisting of a curved arm by which the lever of the grip is forced downward and the jaws of the grip made to clasp the cable. An adjustable weight at one end of the arm (about 35 or 40 lbs.) gives the desired degree of pressure on the lever. The bucket then starts on its journey along the right-hand or loaded cable. On leaving the line and entering a terminal, the lever of the grip runs against a similar arm, the detacher, which forces up the lever and so releases the cable. The bucket-carriage then runs onto a shunt rail and leaves the track cable. The shunt rail, a bar 1⅛ × 3½ ins., set on edge, is supported by hangers that are bolted to timbers above. This rail-tram makes a loop, around which the empty bucket travels by momentum until in position to be started on its return journey. The shunt rails are the same as those used at rail and anchorage stations.

At the main discharge terminal the traction rope passes over a stationary sheave and down to a "floating" sheave, i. e., one moving up and down in guides by means of its frame, thence up over another stationary sheave and so back to the empty side of the line. A small tension-weight is suspended from the frame of the floating sheave. In practice it is found that a very small weight (not over one or two tons) answers for this. The shaft of the stationary sheaves has cog-wheel connections, by which power can be transmitted to a sprocket-wheel and endless chain and used for hoisting coal from the ground to chutes above the main floor, whence it can be loaded in the buckets for transportation to the mine.

THE UPPER LINE.—This tramway is about 4,000 ft. long horizontally, but actual length on the slope is 4,270 ft. The fall in this distance is 484 ft. The span between towers varies from 37 to 753 ft., and their height ranges from 12 to 30 ft. The track cable is 1¼ ins. diameter on the loaded side and ⅞-in. on the empty side. The traction cable is 1 in. diameter. The capacity of the line is 40 tons per hour, with buckets spaced 400 ft., moving 333⅓ ft. per min. It is found that this develops 7½ effective HP., which must be absorbed by the regulating apparatus.

The tramway is in one straight line, and on leaving the hillside to run down to the junction terminal, the exceedingly heavy grade of nearly 46% is required, the dip being 24½°.

To avoid the wear on the track cables at the sharp change in grade at the top of this slope, a rail station of 7 bents, 78½ ft. long (6 panels of 13 ft. 1 in.) is used. A shallow cut for the bucket-ways is also required for some distance here, to permit of the desired grade, and this cut and the station are housed over to exclude the snow.

All the tension-anchorage and rail stations (usually at sharp summits, where a light cut is used) of both lines are also covered with sheds for excluding snow.

AIR COMPRESSOR PLANT.—All power used at the mines is supplied by an air compressor plant. This is located on the west side of the main canon, about ¼-mile below the forks. The building is of brick, 30 by 80 ft. The compressor consists of a compound Corliss engine with steam cylinders 22 × 48 and 40 × 48, and air cylinders 22 × 48 and 36 × 48 ins. Steam at 120 lbs. pressure is used on the high side and at 15 lbs. gage pressure (with vacuum of about 20 to 21 ins. in addition, making about 25 lbs.) on the low side. A pressure of 28 lbs. is used in the low-pressure air cylinder, and one of 85 lbs. in the high-pressure one. The compressor has a capacity of compressing 2,748 cu. ft. of free air per minute when running at 60 r. p. m., using 500 HP.

For a flywheel there is used a rope-drive-wheel of about 14 tons weight. This was adopted so as to provide for connections in case some other source of power be used. Between the steam cylinders there is a receiver. From the low-pressure cylinder the steam passes to a Fairbanks-Morse jet condenser. From there the hot water is pumped to a cooling tower just east of the building. This is 14 ft. by 80 ft. by 18 ft. high. The water falls through riffles to the bottom, whence it drains into an underground tank, and thence is lifted back again into the condenser. Between the air cylinders is an inter-cooler, where the air from the low-pressure side is cooled from its initial heating by the thin tubes being surrounded by water.

Steam is supplied by three 150-HP. Wicks vertical water-tube boilers with automatic stokers, using slack coal. The coal is brought in by the Copper Belt R. R. in 50-ton cars and run onto a switch on the hillside just back of the plant. From here it is dumped into hoppers and led by chutes to bins further down, whence it passes by chutes to the hoppers of the stokers. As the coal comes in gable-bottom cars (intended for either coal or ore) that have come direct from the coal mines (being transferred by the R. G. W. Ry.), there is no hand labor at all after the coal is mined.

The compressed air is forced through a 5-in. wrought-iron pipe for about ¼-mile to a receiver at the forks of the canon. From here a 3-in. pipe leads to the shops at the mouth of the Telegraph mine, about 1,000 ft. distant. A 4-in. pipe, 4,200 ft. long, leads to the Old Jordan mine. The compressed air is used to operate the drills in the mine, and the machine shop, blacksmith shop and the sawmill for shaping mine timbers. At the Telegraph mine the machine shop is less complete, though here there is a power drill-sharpener which saves much tedious hand labor.

SMELTING.—The company smelts its own ores. A fine smelter has been built at Bingham Junction, with a capacity of 750 tons every 24 hours. It is designed expressly for the treatment of copper ores. The U. S. Co. also owns the Centennial-Eureka mine at Eureka, Utah, which is a heavy producer. By mixing the ores from this with those from the mines at Bingham it is found that the smelting is much better and more economical. The ores are hauled in the company's steel ore cars to the smelter.

THE COMPANY ORGANIZATION.—The United States Mining Co. has a capitalization of between $10,000,000 and $12,000,000, and the value of its assets, according to average stock quotations, is about $9,000,000.

The headquarters are at Boston, Mass., and Mr. A. F. Holden is managing director. The superintendent of the mines at Bingham is Mr. Andrew P. Mayberry. The engineers of the company are Messrs. Smith and Lyon, of Salt Lake City. Of these, Mr. J. Femson Smith, Jr., has charge of surveys of the mines, while Mr. Frederick Lyon has attended to construction of the aerial tramway and the compressor plant.

SOME NOTES ON A RECENT ELEVATOR ACCIDENT.

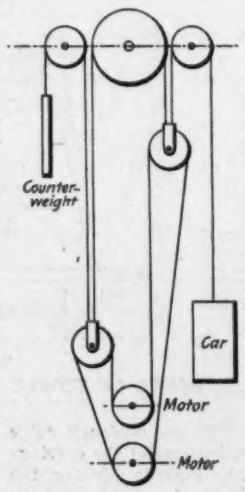
By Chas. R. Pratt,* M. Am. Soc. M. E.

The elevator which ran into the bottom of the hoistway at 74 Broadway on Feb. 2, and seriously injured several passengers, as noted briefly in Engineering News of Feb. 4, was of what is known as the Frazier type of differential traction rope drive. The principle of this form of elevator is easily understood by reference to the diagram sketch herewith, and the following description, which is an extract from a lecture delivered by the writer before the New York Electrical Society in October, 1902:

The illustration is merely a diagram to show the differential rope drive of the Frazier system, and does not represent the actual car and counterweight rope connections. Two electric motors, with driving rope sheaves of about 15 ins. diameter on each armature shaft, set in motion an endless rope, passing under each of the driving sheaves and over two traveling sheaves. These latter are hung from each end of a rope passing over a sheave overhead. The elevator car ropes lead to one of the two traveling sheaves and the counterweight ropes to the other.

The operation is as follows: Suppose the upper motor to be standing still and the lower motor to drive the rope at a speed of 400 ft. per min. This would drive the two traveling sheaves at a speed of 200 ft. per min. Now, suppose the upper motor to drive the rope at a speed of 200 ft. per min., but in the opposite direction from the lower motor. This, then, would drive the traveling sheaves at half the difference between the two rope speeds, or at a speed of 100 ft. per min. Again, suppose that both armatures revolve at equal speeds in opposite directions; then no motion is transmitted to the traveling sheaves, and the elevator car remains stationary.

The object of this device is to control an elevator car entirely by variation of the motor fields, which is perfectly practicable when the driving rope is run at such speed that the difference in speed of motors will give sufficient car speed within a reasonable speed variation of the motors.



It is intended to stop both motors at the lower landing only, and to *stop the car* at all other floors *by causing both motors to run at equal speeds in opposite directions.*

In this elevator we have the most perfect starting, stopping and reversing control that ever has been or ever can be accomplished in an electric, hydraulic or any other kind of elevator. This is certainly a grand thing to attain and encourages an engineer to feel that with this most difficult problem of the electric elevator perfectly solved, all other obstacles must be crushed by such a master stroke of genius. To one unfamiliar with elevator requirements or electrical engineering these other obstacles may seem very insignificant and not even worthy of consideration. They are, for example:

1. To keep a passenger elevator standing still at a landing, depending upon two motors maintaining exactly the same speed, not merely ninety times out of a hundred, but about 5,000 times a day and every day in the year without one single failure. The hydraulic elevator may settle very slowly at a land-

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ing, but the skyrocket Frazier is as likely to jump as it is to creep when passengers are getting in or out.

2. The rope speed:—The least possible rope speed would be with one motor standing still and the driving rope going at twice the car speed; but field variation cannot hold a motor still. With a possible variation of two to one in motor speed the rope would run at four times the car speed, or 2,400 ft. per min., for a car speed of 600 ft. per min.

3. The rope wear:—The limitations of motor speed and hoistway space keep the driving sheaves down to about 15 ins. diameter and forbid the use of the old reliable iron-wire hoisting ropes that have carried passenger elevators for over fifty years without a single instance on record of being the cause of accident. Other kinds of ropes may be just as good, but I would rather have some one else take the risk of proving it.

I do not mean to say that these obstacles to the success of the Frazier elevator, and many more that I have not cited, have not been fully overcome. I merely cite them as a tribute to the courage of those who have risked their reputations and the lives of thousands of passengers in this daring scheme.

The last paragraph of the foregoing extract had in mind the many elaborate safeguards that the Otis Elevator Co. were attaching to the Frazier elevator at 74 Broadway at that time, realizing the great dangers involved in that type of elevator.

They evidently omitted one very essential safeguard, and that is suitable buffers to stop the car easily at each end of its travel. The writer has used air buffers of 18 ins. movement for a car and counterweight to strike at the bottom of the hoistway, at speeds of 600 ft. per min., with no discomfort to the passengers. This was on the old form of double-drum traction rope drive, wherein the landing of either car or counterweight on buffers slacked the rope traction and the driving drums could keep on revolving indefinitely and no injury or danger be incurred. I doubt if this would be altogether practicable in the Frazier type, but had there been suitable air buffers under the car at 74 Broadway, no one would have been injured.

The only other type of traction rope-drive elevator in New York City is one in the German-American Bldg., at the corner of Liberty and Nassau Sts. It is a simple and safe form of elevator, with none of the dangers of the Frazier type; it has the air buffers that I refer to at each end of the counterweight travel and has run into them several times at 600 ft. per min. speed with no injury or discomfort to the passengers.

No elevator car should carry passengers at a speed of over 350 ft. per min. which depends upon automatically cutting off its hoisting power in order to protect it from running at full speed into the top or bottom of the hoistway. In other words, the arrival of a high-speed elevator car at the top or bottom floors should positively, safely and comfortably stop its further travel. This is true of the Otis vertical hydraulic elevator, the Sprague-Pratt electric elevator, and all simple traction elevators with air buffers under car and counterweight.

The question may be asked: Why should the oldest, largest and most conservative elevator company in the world take such unwarranted risks in installing a Frazier elevator? For the simple reason that there is a great demand for high-speed electric elevators, and no electric control has yet been built that will handle the armature current with entire satisfaction, hence the attraction of field control as in the Frazier elevator.

When one considers that a high-speed electric elevator motor takes a starting current as high as 550 amperes on 115 volts, and a running current of 300 amperes, and half these currents on 230 volts, while a field control for the same horsepower has to handle only 2 or 3 amperes, the electrical advantages of the latter over the former are apparent.

Mr. H. Ward Leonard very cleverly controlled hoisting motors by varying and reversing the field of an independent generator for each hoisting motor. The principal objection to his system is the first cost of an independent generator for each motor and the power consumed in keeping these generators running continuously. The Ward Leonard device has none of the dangers of the Frazier type, and its additional generator and power units and power consumed can hardly be greater in cost than the two slow-speed, large-size motors of the Frazier type, running continuously.

Mr. Thos. E. Brown, Jr., Chief Engineer of the Otis Elevator Co., once said to the writer: "The only perfectly safe high-speed passenger elevators are the old Otis vertical hydraulic and the Sprague-Pratt electric elevator."

Both of these elevators have the following characteristics of safety in common:

(1) The car can not by any possibility run into the top or bottom of the hoistway, provided proper hoistway clearance is given.

(2) No dangerous acceleration of speed is possible, except by the breaking of ropes or of such hoisting apparatus as has never yet been known to fail on either of these elevators.

I can find no better words to close this article than the last remarks in my lecture already referred to:

> The electric elevator as a system, for any kind of service whatever, needs no defense to-day; it is logically and pre-eminently the best. But the demand for safety and reliability in high-speed office-building service will never let it replace the hydraulic until its safety and reliability for that service has been proved beyond all question. It will be a long, hard struggle to accomplish this, as I well know from personal experience. But early prejudice has been overcome, and any attempt to build a high-speed electric elevator for office-building service will receive more encouragement than opposition, and no difficulty will be met with in finding a building to install it. This confidence and encouragement should not be abused by risky experiments; let safety and reliability be preserved in every step of our progress towards this end.

SPECIAL REPORTS ON TYPHOID FEVER AND WATER SUPPLY.

Th unusual prevalence of typhoid fever of late and the increasing interest in the cause and suppression of such outbreaks has led us to make a special effort to secure accounts of the epidemics and milder occurrences of that disease now existing or which have been reported of late but never adequately described. In addition, we have taken steps to secure information relating to the conditions prevailing in a number of places where typhoid is endemic and the water supply is of a particularly doubtful character. As a result of our inquiries we give below some statements, made at our request, by city officials in Philadelphia, Lowell, Mass., and Waterloo, Ia., and also a report on several outbreaks in Western Pennsylvania. Elsewhere in this issue will be found a lengthy report on the serious typhoid epidemic now prevailing at Columbus, O. In subsequent issues we expect to present further articles on typhoid fever and water supply.

The Effect of Filtered Water, so Far as Yet Available, on Typhoid Fever at Philadelphia.

By A. C. Abbott,* M. D.

It is with a little hesitation that I attempt to supply the information desired by your journal regarding the effect of filtered water upon typhoid fever in those sections of the city thus far supplied with it.

First of all, the district receiving the filtered water in Philadelphia is comparatively a small one, representing only about 7½% of the entire population of the city. Many of these people, while living in that district, are engaged during the day in other parts of the city, and, therefore, get access to water that has not been filtered. Again, the length of time that that district has been getting filtered water is comparatively short. However, I have recently interested myself in an effort to discover if any difference could be found between the typhoid incidents in that district and those of other districts receiving water from the same source, but unfiltered. We have in Philadelphia six pumping stations, three supplying water from the Delaware, and three from the Schuylkill. It is at one of the Schuylkill stations that the filtration plant is located and in operation. I have calculated the number of cases of typhoid fever in each of the Schuylkill districts per 10,000 people living in that district, and the results may be stated in relative terms about as follows:

Roxborough, getting the filtered water, may be taken as 1; Queen Lane, getting unfiltered water, may be taken as 1.7; Belmont, getting unfiltered water, may be taken as 2.15.

From these figures you may easily see that though a final opinion would be premature, yet the district getting the filtered water has, nevertheless, a great advantage over those getting the unfiltered water.

The number of typhoid cases and deaths in Philadelphia during 1902, 1903 and January, 1904, were as follows:

1902, number of cases, 5,006; deaths, 588. 1903, number of cases, 8,701; deaths, 957; January, 1904, number of cases, 465; deaths, 54.

*Chief of the Bureau of Health, Philadelphia, Pa.

The Typhoid Fever Outbreak at Lowell, Mass., in the Summer of 1903.

By George Bowers,* M. Am. Soc. C. E.

In response to a request from Engineering News I have prepared the following statement regarding the typhoid epidemic here last summer:

The city of Lowell has been supplied entirely with driven-well water since 1896, and has been very free from typhoid fever since that date. The large cotton mills have a water supply of their own, with a 2,000,000-gallon reservoir situated at an elevation of 33 ft. above the city reservoir. These works were built many years ago before there was any public supply. After the city waterworks were completed several connections were made between the two systems, controlled by check valves; these connections were made to allow the mills to obtain water from the city mains in case of fire. At such a time the pressure in their pipes would be so reduced that the valves would open automatically and allow the city water to enter their pipes; when the pressure was restored the valves would close and the two systems be separated again.

On July 18, 1903, at 8 p. m., a large fire broke out in mills of the Merrimac Manufacturing Co. and lasted until 2 a. m. the next day. The recording pressure gages show that soon after the fire began the check valves opened and the city water flowed into the corporation pipes. Immediately after the fire the corporations began pumping to refill their reservoirs, but after several hours work little headway had been made. This led to an investigation, which revealed the fact that one of the check valves remained opened when the increased pressure was applied, driving the polluted Merrimac River water into the city main and mixing it with driven-well water at a point in the center of the city where there is a large consumption of water. In a few days a large number of people were taken violently ill and an epidemic of cholera morbus ensued. In about three weeks a great many cases of typhoid fever were reported, followed by a serious epidemic of the same.

At every connection is a gate controlled by the city, and these gates were closed soon after the typhoid fever broke out and have remained closed. The city has placed extra hydrants in the streets near the corporations for their benefit, and the mills themselves are enlarging their own water supply. In the spring the city will remove all connection between the two systems.

This occurrence illustrates in a striking manner the damage which a comparatively small amount of polluted water may do.

Typhoid Fever Statistics by Weeks at Lowell, Mass., in Summers of 1901, 1902 and 1903.
(For week ending.)

1901.	Cases.	Deaths.	1902.	Cases.	Deaths.	1903.	Cases.	Deaths.
Aug. 3...	0	0	Aug. 2...	2	0	Aug. 1...	0	1
Aug. 10...	1	0	Aug. 9...	1	1	Aug. 8...	0	0
Aug. 17...	0	0	Aug. 16...	0	1	Aug. 15...	13	0
Aug. 24...	1	0	Aug. 23...	2	0	Aug. 22...	75	1
Aug. 31...	4	0	Aug. 30...	0	1	Aug. 29...	41	1
Sept. 7...	3	0	Sept. 6...	4	2	Sept. 5...	20	2
Sept. 14...	1	1	Sept. 13...	1	0	Sept. 12...	7	2
Sept. 21...	1	0	Sept. 20...	2	0	Sept. 19...	8	2
Sept. 28...	2	0	Sept. 27...	3	1	Sept. 26...	4	0
Total....	13	1	Total....	15	6	Total....	168	9

The accompanying table shows the number of cases of typhoid fever and deaths from the same reported during the months of August and September for the last three years.

*City Engineer, Lowell, Mass.

A Mild Outbreak of Typhoid Fever at Waterloo, Ia.

By G. J. Mack,* M. D.

In response to your request for information about typhoid fever in Waterloo, I would say that our statistics on that subject are not very valuable. Not all typhoid cases are reported and we know that a good many cases that are not typhoid are reported as such. Deaths are not reported, under our present laws, for any ordinary diseases, consequently I can only give an estimate. To the best of my knowledge, I would say that there were about 100 cases of typhoid and about 10 to 15 deaths from it during the last year.

As to the cause, I can give no definite opinion. Numerous analyses, chemical and bacterial, have been made of our water supply, which is pumped from the Cedar River and run through Jewell filters, and in no case has anything been found in the way of sewage contamination or typhoid germs.

The milk supply we find comes from numerous farms in all directions from town, and no particular supply can be found to have more typhoid cases than any other.

A majority of the cases are among the best class of our people, living in modern houses with plumbing and sewer connections, nearly all of which have been carefully inspected and pronounced in good order. The last two summers here have been excessively wet, and quite a good part of the city has been flooded by creeks four or five times during the last two years, but there is as much typhoid in the higher and unflooded districts, if not more, than in the lower sections. Many of the cases have been very severe, more so than the average, probably.

In regard to suppression, we try to get people to boil all drinking water and keep their premises in good condition. I believe the cases which have occurred within the last ten days or so have not been quite as severe as they were. Temperature has been zero or below day and night here for ten days. No rain and little snow since Oct. 14. There are probably 25 or 30 cases now under treatment.

Additional Outbreaks of Typhoid Fever in Western Pennsylvania.†

Considerable interest has been aroused, not only in the immediate locality, but also throughout the entire country, by the great prevalence of typhoid fever in the western part of the State of Pennsylvania, notably near Pittsburg. The most prominent study has been made of the epidemic at Butler; and it is thought that it will be interesting to record the facts for some minor epidemics.

THE KITTANNING AND WICKBORO EPIDEMICS.

Kittanning, Pa., the county seat of Armstrong Co., is located on the left bank of the Allegheny River, about 44 miles above Pittsburg. The population in 1900 was 3,902 and it is estimated to have about 5,000 people now. The principal industries are iron and steel mills and pottery works.

The town is supplied by the Armstrong Water Co., from a pumping plant located on the bank of the river. The works were originally built in 1871 and have been added to and improved since, but no system of filtration or purification is in use. It is understood, however, that a mechanical filter plant is expected to be installed during the coming season. Water is obtained from a crib placed near the middle of the river, from which the water flows into a cement-lined pump well at the pumping station. Water is pumped direct to a reservoir of about 2,000,000 gallons capacity and located on a hill back of town; thence, the water flows through a distribution system of about six miles of pipe. The pumping capacity of the station, with two pumps, is about 6,000,000 gallons and the average daily use is estimated to be about 750,000 gallons.

The town has sanitary sewers, which empty into the Allegheny River through a 16-in. pipe just below the settled part. Some storm sewers are also said to be in use.

The village of Wickboro adjoins Kittanning upstream and on the north, and has about 1,000 people. Its water supply comes from the Armstrong Water Co. and from the Rayburn Water Co.; the latter furnishing spring water. There is no public sewerage system at this place, but part of the houses drain into the Allegheny directly and part into a large swamp, which occasionally overflows into the river. Thus sewage from many people is delivered into the river within a half mile above the intake of the Kittanning water supply.

The drainage area of the Allegheny River above Kittanning is about 8,800 square miles. The important tributaries coming in above are the Mahoning and Red Bank Creeks and Clarion River on the left, and French, Oil and Connewango Creeks on the right bank of the stream. A list of cities and villages on the drainage area having some 10,000 or more people in 1900, together with the distance above Kittanning and the stream on which each is situated, is given in Table I.

The population upon the drainage area is 24.6 per sq. mile, which is high enough. The opportunities for prompt conveyance of infection are good, as has been pointed out by Prof. Wm. T. Sedgewick in his report upon "The Sources of Typhoid Fever in Pittsburg," in which he said:* "I have never seen a river so well adapted in every respect to the swift conveyance of microscopical impurities from great distances."

Typhoid fever has for many years been prevalent at Kittanning, as it has, in fact, elsewhere all over the country and noticeably in Western Pennsylvania, where water supplies are derived from polluted streams without any means of purification. Table II., showing the number of cases reported by months for the past seven years, reveals the actual conditions.

The large number of cases of typhoid in January and February, 1898, attracted some attention even in Pittsburg, as the Filtration Commission was conducting its investigation at that time. Analyses of the river reservoir and tap waters made at that time (see page 321, Report Pittsburg Filtration Commission, 1899) showed all three to be about the same in composition and like the river at Pittsburg.

It will be noticed that the death rate is high, more than it seems reasonable to expect. The conclusion to be deducted from this is that all the cases were not reported, especially in the first two years, and that later, when the people and physicians had become more accustomed to expect disease, perhaps not all the cases were typical typhoid fever.

While during most of the years the rate is high, the month of November, 1903, stands out above all others and is worthy of special study. The summer months of July and August, in both 1902 and 1903, are also notably high.

The reported cases from Kittanning since Dec. 1, 1903, by weeks is shown by Table III.

The deaths chargeable to the above epidemic number four up to Feb. 5, or about 5.5%, all of which occurred in December.

The large number of cases in the early part of December attracted the attention of the officers of the State Board of Health, who were on duty at Butler, Pa., and an investigation was made and samples of city water collected upon both Dec. 18 and Dec. 25, for analysis. The samples, while not containing an excessive number of bacteria, indicated a polluted water supply for the test for the colon bacillus was positive in all but two samples.

Samples collected Dec. 24 by Pittsburg representatives interested in the situation confirmed the other determinations with still higher numbers of bacteria and B. Coli Communis. The river, in fact, showed about the same as at Pittsburg and the tap water somewhat higher than at the latter place.

All of the recent cases have been well distributed over the town and not bunched in any given locality. Milk is supplied by nine dairymen in Kittanning, being carried about in large wagon tanks and then deposited in the personal receptacle of each customer, as is the custom throughout Western Pennsylvania. As far as can be learned, none of the families and none of the employees of such dairymen have been ill during the past season with typhoid fever, or other diarrhœal disease.

The village of Wickboro did not require cases of typhoid fever to be reported until October 1, 1903, since when the number has been reported as follows:

	Cases.	Deaths.
October, 1903	2	..
November, 1903	1	..
December, 1903	15	1
January, 1904	13	1
February, 1904 (to date)	0	0
Total	31	2

All of these cases in Wickboro are supplied at the home or place of employment with water common to the Kittanning water-works system.

It is unpleasant to record in passing, but necessary to complete the history, that some spirit of jealousy and antagonism has been occasioned between the state and local authorities. The State Board of Health, believing the public water supply to be the cause of the present epidemic, caused notices of warning to be posted in public places, stating such water to be dangerous and that it should be boiled. The local authorities pulled own and destroyed the notices. The state officials sought an injunction restraining such disturbance of notices and on Jan. 25 a preliminary hearing was held, at which time the Court ordered the defendants prepare an answer.

The conclusion to be drawn from the history of this epidemic, as given briefly above, is that the public water supply was the specific means of infection and probably has been in past years the cause of the continual presence of typhoid fever in the town. The lesson to be learned is not new; it is known and has been known for some time, and it only needs sufficient public sentiment to bring about the application of the proper remedy.

It is of interest to compare the dates of the

TABLE I.—Principal Cities and Villages on Allegheny River Drainage Area above Kittanning, Pa.

Place.	Stream.	Distance, miles.	Population in 1900.
Du Bois, Pa.	Clarion River.	83	9,375
Oil City, Pa.	Allegheny River.	87	13,264
Meadville, Pa.	French Creek.	106	10,291
Jamestown, N. Y.	Connewango Creek	172	22,892
Bradford, Pa.	Allegheny River.	202	15,029
Olean, N. Y.	Allegheny River.	203	9,462

TABLE II.—Reported Cases of Typhoid Fever at Kittanning, Pa., July, 1897, to December, 1903, Inclusive.

Months.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	Average.
January	...	10	5	16	5	6	2	7.5
February	...	5	6	24	4	0	4	7.2
March	...	1	1	9	3	3	2	3.3
April	...	13	1	4	12	4	2	6.5
May	...	0	2	3	3	2	2	3.2
June	...	0	0	2	5	4	3	2.2
July	...	1	1	0	2	6	11	4.8
August	...	1	0	0	3	1	18	4.3
September	..	3	3	0	3	1	7	2.6
October	....	2	3	1	6	3	1	2.9
November	..	1	2	0	2	2	1	1.7
December	..	0	7	4	2	2	0	2.5*
Total cases		8	45	20	76	47	52	48*
Per 10,000	...		120	52	196	111	114	117*
Total d'ths		3	7	3	5	1	5	4.2†
Per 10,000	...	18.9	7.8	12.8	2.4	10.9	10.9	10.2†
Pr ct., deaths	...	15.6	15.6	6.6	2.1	9.6	6.1	8.7†

The year 1897 only reported for last six months.
*Not including December, 1903.
†Not including year 1903.

TABLE III.—Typhoid Cases Reported by Physicians at Kittanning, Pa., for the Ten Weeks Ending Jan. 31, 1904.

Week beginning.	No. cases.	Week beginning.	No. cases.
Dec. 1 (5 days)	3	Jan. 3	2
Dec. 6	12	Jan. 10	6
Dec. 13	27	Jan. 17	5
Dec. 20	25	Jan. 24	3
Dec. 27	6	Jan. 31	3

*See Report of Pittsburg Filtration Commission, 1899.

TABLE IV.—Cases of Typhoid Fever Reported by Weeks in Those Wards of Pittsburg Obtaining Water from the Allegheny River.

Week beginning.	Cases reported—Pittsburg.	Kittanning.
Dec. 1 (5 days)	64	3
Dec. 6	109	12
Dec. 13	140	27
Dec. 20	138	25
Dec. 27	91	6
Jan. 3	94	2
Jan. 10	73	6
Jan. 17	81	5
Jan. 24	76	3

*Health Officer, Waterloo, Ia. Dr. Mack prepared this statement on Feb. 1.

†Based on information obtained on the ground for this journal by Mr. F. E. Field, C. E., of Pittsburg. Most of the data were secured through the kindness of Dr. T. N. McKee, County Quarantine Officer, who represents the State Board of Health, and Dr. H. P. Stone, Secretary of the Kittanning Board of Health.

cases in Kittanning with those occurring in Pittsburg at about the same time. (Table IV.)

It will be seen that the increasing cases in Pittsburg occurred at about the same time as the Kittanning outbreak, and there has not been an alarming amount since that time. Neither has there been a marked increase in bacteria or B. Coli, except during the first of the flood, which was to have been expected. Whatever caused the sudden increase at Kittanning had its effect at the same time at Pittsburg.

This indicates that this outbreak has had no particular effect upon the water of the river at the Brilliant pumping station (Pittsburg), probably on account of the great dilution, and that this particular local pollution is only an example of what is going on all the time, here and there and up and down the stream, perhaps not in as concentrated doses, but still enough always to keep the infection fresh and abundant for the people below and at the large cities of Pittsburg and Allegheny, which are at one and the same time both the great collection and the great distribution centers of such infectious diseases.

FORD CITY EPIDEMIC.

Ford City is also in Armstrong Co., and is about four miles below Kittanning. It is the next largest place in the county. The population in 1900 was 2,870 and is now about 3,000. The water supply at this place is derived from the pumps at the plant of the Pittsburg Plate Glass Co., and water is delivered into a reservoir of about 3,000,000 gallons capacity and then flows through the distribution system of about five miles of pipe. The use of water is probably not over 250,000 gallons per day.

It was not compulsory to report cases of typhoid fever in Ford City until recently, but the figures, so far as obtainable, are given in Table V.

TABLE V.—Cases of Typhoid Fever Reported at Ford City, Pa., During the Nine Weeks Ending Feb. 6.

For week ending.	No. of cases.	For week ending.	No. of cases.
Dec. 12	6	Jan. 23	0
Dec. 19	4	Jan. 30	0
Dec. 26	0	Feb. 6	1
Jan. 2	1		
Jan. 9	3	Total	17
Jan. 16	2		

Two things are prominently shown in the above table: (1) The cases are numerous about the same time as at Kittanning, and (2) the number is not anywhere near as many in proportion. The conclusion is that the source of infection is the same general one, that is, the river water, but that for some reason the infection is not dealt out as liberally or in as strong doses. It is said that the place and water-works being new, not yet being owned by the town or an independent water company, the use is not general and wells are also still used to some extent. This seems probable. In addition, the large size of the reservoir compared to the use of water makes the pollution less active on account of sedimentation.

The deaths from typhoid fever at Ford City since March 24, 1903, have been as follows: March 24, 1; Nov. 21-25, 5; Dec. 1, 1; Dec 11, 1; Jan. 16, 1; Jan. 22 and 23, 2; total, 11.

It is evident from the number of deaths in November that typhoid fever existed to a considerable extent prior to the reported cases in December.

THE GREAT FIRE AT BALTIMORE, MD.

A great conflagration destroyed a large part of the business section of Baltimore on Sunday and Monday of this week. Starting on Sunday morning, the fire raged for nearly 30 hours, eating its way from block to block, until an area one mile long and a quarter of a mile wide was a blackened ruin. Within this area was embraced many of the leading mercantile and manufacturing establishments of the city and most of its large financial institutions. The number of buildings destroyed is from 1,000 to 1,500, and the property loss is variously estimated by bankers and business men at from $65,000,000 to $100,000,000.

The fire broke out about 11 a. m. on Feb. 7 in the dry-goods store of Hurst & Co., at Hopkins Place and German St. This was a six-story brick building of old-time construction and was located in the heart of the retail business district. In a short time the whole structure was a mass of flame, but there was no thought or sign of wider spread disaster until a series of explosions tore apart the walls and flung the flames and burning debris over the adjacent buildings of the block. These caught fire and under the impulse of a strong southwest wind the fire began its fierce progress in a northeasterly direction. The buildings in the path of the flames were for the most part of a construction which offered little resistance to fire and their contents were highly inflammable. Here and there were buildings of more modern and fire-resisting construction and they still stand so far as walls and floors are concerned, but are entirely gutted of their contents.

The progress of the fire was steady and irresistible. The fire fighters were gradually crowded back and their efforts scarcely impeded the advance of the flame. Aid from other cities was asked and given, and buildings in the path of the fire were razed by dynamite, but all to no avail. The flames progressed almost unchecked until stopped by the natural barriers furnished by the Harbor Basin and the small stream known as Jones Falls.

At the present time, Tuesday, Feb. 9, it is possible only to give a few general impressions of the conflagration as it appeals to the engineer and municipal officer.

There seems good reason to believe that had the explosions noted not followed the fire in the Hurst Building the fire would never have spread beyond the immediate vicinity. These explosions were due to gasoline stored in tanks in this building and used for operating gas engines, and they spread the flames to half a dozen buildings in almost a moment's time.

The fire, once started, encountered only combustible structures, brick buildings three to five stories high, with timber roofs and floors, with frames either all of wood or combined iron girders and wood joists and flooring construction. These burned and collapsed in heaps.

Of the fireproof buildings in the burned district only a very few resisted the attack of the flames. Two of these were the City Hall and the Court House, both monumental structures of stone, with few windows and heavy masonry walls. Their exteriors are damaged, but the fire did not get inside. The other buildings which were saved were of similar construction. The steel skeleton tall office building type of construction was best represented by the 16-story Continental Trust Building, which was located in the very heart of the district where the fire raged fiercest. As in most office buildings, the window openings formed a large percentage of the wall area. The fire took out every window and cleaned the building bare of its combustible contents. A partial examination from the street shows all the floors in position but swept clear of partitions. The walls are standing blackened, but apparently structurally in good shape. Detail failures of the fireproofing are visible in places. The other and smaller buildings of the same type are in practically the same condition. At the time of writing it is impossible to visit these structures, and a description of their condition in detail is therefore postponed to a later issue.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a butting collision on the Canadian Pacific Ry. at Sand Point, Ont., on Feb. 9. Two opposing through passenger trains were to have passed at the siding at Sand Point, but the westbound train passed the siding; the trains collided at full speed some three miles west of the siding. At least ten persons were killed, half of the number being passengers.

RUSSIAN RAILWAY ACCIDENTS in 1902 are summarized in a report of the Russian Ministry of Ways and Communication. As recorded in the U. S. Consular Reports for Feb. 5, the total number of accidents reported was 9,890, of which 1,012 were collisions and 1,521 derailments. The casualties in these wrecks were 1,529 deaths and 7,908 persons injured.

SIX THEATERS HAVE BEEN CLOSED in New York City by the Mayor during the past week, for failure to make alterations as were ordered by the city authorities after the Iroquois fire in Chicago. The theaters involved are none of first importance. The alterations in question deal with matters like the following: the substitution of a brick proscenium arch for a wooden one, in one theater; replacing gallery benches by individual theatre chairs, in another; providing sprinklers and standpipes, and removing the heating boiler from under the auditorium, in another; etc. This action on the part of the city authorities implies that all other theaters have made such changes as render them safe, in the light of what occurred during the Iroquois fire.

CALKING A COFFERDAM BY THE FREEZING PROcess is being tried in St. Louis. The foundations for the new power house of the Union Electric Light & Power Co., foot of Biddle St., are being put down inside of a steel cofferdam. The cofferdam is formed of steel interlocking sheet-piles, each pile made of a single steel channel, 35 to 50 ft. long, and alternately Z-bars and angles riveted along the edges of the channels to form a dovetail with room for calking. One compartment of the cofferdam gave much trouble from leakage. The piling in some places had gotten out of line sufficiently to make it impossible to tighten the joints by calking with wood strips or oakum and water came in in large quantities. There is a cold-storage plant only two blocks from the site, and this suggested the idea to close the leaks by freezing. Ammonia pipes were laid from the cold-storage plant, and freezing pipes were sunk alongside the faulty joints of the cofferdam. The experiment gives promise of being entirely successful.

STEEL PASSENGER CARS to the number of 200 are to be built by the American Car and Foundry Co. for the New York Rapid Transit R. R. The cars will be 51 ft. 2 ins. long over all, and 8 ft. 7 ins. in extreme width. The cars have been ordered after thorough tests of a sample car.

WIRELESS TELEGRAPH COMMUNICATION is to be attempted between Para, Brazil and Manaos, 1,000 miles up the Amazon. A land line telegraph between these points is impossible and the submarine cable recently laid in the bed of the river to connect them is said to be out of order three-fourths of the time and the cable company have therefore purchased the rights for a wireless telegraph installation. From Manaos the service may be extended to Iquitos and other centers of the rubber trade on the upper Amazon.

AN AUTOMOBILE RAILROAD is a recent French invention referred to in a report by U. S. Consul B. H. Ridgeley of Nantes, France, who quotes as follows from "L'Illustration:

One of the most striking novelties of the automobile salon is the road train of continuous propulsion of Col. Ch. Renard, Director of the Park Aerostatique de Chalais-Meudon. This train is designed to transport passengers and merchandise at a moderate speed.

In this train there is, so to speak, no tractor. One of the carriages, the head one, is furnished with a motor sufficiently powerful to draw the entire train at the desired speed. The power generated by the motor is distributed to all of the vehicles of the train. The adherence is therefore no longer due to the weight of the tractor, but to the weight of the entire train. One can thus make the tractor as light as an ordinary carriage and hitch it to as many carriages as desired without fearing the least sliding. The automobile at the head of the train, provided with a motor of 50 HP., weighs only 1½ tons, and it suffices to furnish the necessary energy to draw a mixed train—passengers and merchandise—formed of seven or eight light vehicles, carrying a load of 10 tons, at the rate of about 12 miles an hour. The method of transmission of the energy from the motor to the carriages is purely mechanical. It consists of a longitudinal shaft running from one end of the train to the other. This shaft is articulated in a manner to permit the train to mold itself to the most complicated curves.

The parts uniting the different carriages are easily uncoupled to permit the separation or reunion of the carriages at will. Under each carriage there are cogs which transmit the rotary movement of the shaft to an arrangement similar to that used in automobiles and working one pair of wheels. All of this obeys the manipulation of one machinist on the locomotive carriage at the head of the train. To conduct such a train involves no more difficulty than that of running an ordinary automobile. The second principle applied by Colonel Renard is that of "correct turning." It consists of a special disposition by means of which each carriage of the train follows exactly the track of the preceding one.

The automobile train furnishes a practical solution of industrial transportation over interior roads and highways. It will, in many cases, do the services of railroads in regions not yet reached by railway or tramway lines. It is, in short, a tramway without rails and opens up a great prospect of practical possibilities in the field of transportation.

The same problem has been worked out by an American inventor in a different way. A similar train of vehicles is used, but the head one is a complete electric power station with a gasoline engine and generator and the electric current is used to drive motors on this vehicle and on each vehicle in the train following.

A CHANGE IN THE MEETING of the American Institute of Mining Engineers has been made, Atlantic City being substituted for Baltimore on account of the great fire in the latter city. The date remains the same, Feb. 16 to 19. Fuller notice of the change will be found in the column of Engineering Societies in the supplement to this issue.

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ADVERTISING RATES: 20 *cents a line. "Want" and "For Sale" notices, special rates, see page XXIV-XXIX. New copy for standing advertisements should be received one week in advance of publication: new advertisements, Monday morning. The pages containing "Want," "For Sale" and "Proposal" advertisements are held open until Wednesday at* 10 *a. m.*

The great calamity by which the business district of Baltimore has been destroyed directs public attention toward the conflagration hazard, as it is termed among insurance experts. This is a hazard to which the business districts of most American cities are more or less exposed, and will continue to be until buildings made of incombustible materials shall have generally taken the place of those built of wood. Even then, the stocks of inflammable materials stored in buildings used for mercantile purposes will require the provision of efficient means of fighting fire to secure real safety.

The work of extinguishing fires may be compared to the application of brakes on a car descending a long and steep grade. If the brakes are applied with their utmost power and yet the force accelerating the car exceeds the effort of the brakes to retard it, the car will continue to gain in speed; and the faster it runs, the less effective is the braking force.

In the same way a fire which grows in intensity despite the streams of water poured on to check it, is likely to continue to extend, and the more rapid and fierce the spread of the flames, the less efficient is the work of the firemen to check them.

Experts are well agreed that in the thickly built up sections of most large cities, particularly in the districts where large stocks of inflammable goods are stored, the ordinary methods of fighting fire by fire engines and hose do not afford a thorough protection. A complete system of large fire mains with roof hydrants and nozzles, designed to deliver a huge volume of water from a high level is agreed to be the system demanded to prevent conflagrations in such districts.

Several cities have already installed such a system of fire protection and others are likely to do so now that Baltimore has suffered such a calamitous loss.

The "water curtain" idea has been brought forward again in the public prints as a result of the Chicago theater fire, and it has been proposed that a "water curtain" or "miniature Niagara" should be so located as to fill the proscenium arch opening in a theater in case of the outbreak of fire on the stage.

The defects of such a device are so obvious that it will hardly receive serious consideration. Had such a system been in place and in perfect operative condition in the ill-fated Iroquois theater, it could not have prevented the sudden outburst of smoke and flame which drove the audience into panic and later suffocated many of the victims.

If such a volume of water is to be let loose at the top of the stage, the thing to do with it is to put it on the fire by automatic sprinklers and let some more substantial barrier than falling drops of water be put between the audience and the stage. It may be added that the operation of any such water curtain, either purposely or by design, would be practically certain to send the audience into a panic and flight, whether there were any fire or not.

The "water curtain" seems to be a Chicago idea. We illustrated one installed at the Chicago Public Library in our issue of June 8, 1899, and pointed out then its inherent defects and doubtful value as a means of fire protection. It has been recently adopted, however, in a St. Louis dry goods store, to protect it against exposure fires on two sides. A system of sprinkler pipes at the cornice connects to a supply pipe which has connections at the bottom where lines of hose from a fire engine may be attached. The St. Louis "Globe Democrat" quotes the Chief of the St. Louis fire department as follows:

> Chief Henley stated yesterday that he knew of no other building in the country where so perfect or such extensive water-curtain protection is provided for the outside of the building. "When a sheet of water is turned on the windows from either side," said Chief Henley, "the fiercest flame will not crack the panes. The connection is so arranged that water can be turned against any two rows of windows at a time or against an entire side."

If the building is glazed with wire glass, the water curtain might be of some benefit in preventing the fire from reaching the interior; but any other glass would be certain to break when exposed to the combined action of flame and a stream of cold water. If the exposure fire were a strong one, moreover, the water curtain could not furnish enough water to amount to much in keeping the panes cool.

Compulsory sewage purification for all cities and villages in Minnesota after Jan. 1, 1905, is about the sum and substance of the rules adopted on Jan. 12 by the Minnesota State Board of Health. Elsewhere in this issue we publish the rules in full, the conditions leading up to them, and the attitude of the Board on the subject, all set forth by Dr. Henry M. Bracken, Secretary of the Board. Some may object that such extreme measures are sure to defeat their own ends. We are not yet ready to agree to such an opinion, although we feel that the regulations are radical if not revolutionary. We would call attention, however, to the fact that the purification required is septic tanks, filter beds, or both, as the Board may require; that the plans must be approved by the Board; and that while it makes the discharge of untreated sewage into any water of the State a nuisance, punishable as a misdemeanor, it will decide where and when to bring legal action. In other words, every municipality is put on the defensive, and after Jan. 1, 1905, may have to show cause why it should not be fined for not having provided sewage purification works. The Board is certainly to be commended for the underlying principles on which it is acting; namely, that water pollution is an offense for which every city and village is liable to answer.

The first meeting of the new Sanitary Section of the Boston Society of Civil Engineers was so successful as to promise well for the new departure. The attendance was large and the papers and discussions were numerous but brief and to the point. The subject was the septic tank, and will be followed on March 2 by another that should be equally productive of facts and opinions; namely, the flushing and cleaning of sewers.

The papers and discussions on the septic tank, mentioned in the foregoing lines, when published in full in the "Journal of the Association of Engineering Societies," will be a valuable addition to the literature of sewage disposal. We do not suppose, however, that any one is so sanguine enough to suppose that they will form [illegible] the beginning of the last words on the subject. The only conclusion on which all or nearly all agreed was that the septic tank is at best only a partial solution of the old sludge problem. Some went so far as to doubt whether it was even that, as a rule, while several were quite pronounced in favor of sedimentation without anaerobic action, and at least one speaker was confident that intermittent filtration, alone, is still unsurpassed for localities, like many in Massachusetts, where cheap sandy land is available.

Few people realize the rapidity with which the trade of the United States with its neighbors on the north and on the south has increased during the past decade. Statistics are usually dry reading, but there is great interest in the fact, set forth in a bulletin just issued by the Department of Commerce, that our exports to Canada during the year just closed were much more than double what they were ten years ago. Making the comparison in figures, and omitting the small numbers, which only tend to confuse the mind, we sold Canada 57 million dollars worth of goods in 1893, and 90 million dollars worth in 1898, while in the year just closed the exports were nearly 131½ millions.

Imports from Canada have also grown, but on a smaller scale. The total of imports was 34½ million dollars in 1893 and 54 millions in 1903. In general we buy from Canada goods in the rough, such as lumber, logs, pulp and ores, and send her in return highly finished manufactured goods.

Our trade with Mexico is on a much smaller scale and is much more evenly balanced between imports and exports. In 1893 we sent to Mexico only 16½ million dollars worth of goods and in 1903 we sent 43½ millions, while we received from her during the last-named year goods to the value of 41 millions. To all South America our exports in 1903 were only 46 million dollars, or very little more than to Mexico alone.

We commonly think of export and import traffic as being conducted solely by ocean transportation; but our trade with Mexico and Canada is chiefly by rail, and these countries in 1903 took about one-seventh of our total exports.

As announced in another column there is shortly to be established at McGill University, Montreal, a special department or school devoted to railway engineering. The announcement raises anew the question how far it is best to go in the direction of specialization in engineering education.

It is true, of course, that special courses in railway engineering are not a new thing. Such courses have figured in the catalogues of a number of American engineering schools; and considerable has been done in the way of special instruction in this field, particularly at Purdue University, which was the first to install a stationary locomotive for instruction and experiment, and at the University of Illinois. Cornell also is building up a railway engineering department and Columbia is working in the same direction.

The question, occurs, however, whether a boy can be better fitted for the railway service by a special school or department than is already done by the existing engineering courses?

We notice from a preliminary announcement regarding the school that the work proposed to be done will include the following:

> (1) Location, including all branches of surveying.
> (2) Construction, including the laying out of work, the construction of bridges, buildings, etc., tracklaying and ballasting, organization, specifications, etc.
> (3) Operation, including (a) maintenance of way and structures; (b) the conducting of transportation; (c) equipment, organization, legislation, etc.

It is doubtful whether the boy graduating from such a school would be any better fitted to do work on location or construction or on the design of bridges, buildings or masonry than a student who had taken the regular course in civil engineering. The work of the operating department, it is true, is hardly touched on in engineering schools at present; but while instruction in this would be of some benefit, it can hardly fit the

boy at graduation for any responsible executive position in that department; and there are very few graduates of a technical school who would be willing to begin at the foot of the ladder as a brakeman or fireman or office clerk, as well as many good reasons why it would not be for their best interests to do so.

We would not be understood as condemning the scheme of special instruction in railway engineering by any means; but only as pointing out some of the difficulties in the way of securing large results. The educator is practically limited to what can be done in four years with boys beginning at 16 to 19 years of age. It takes so large a part of those four years to ground a boy in the foundation studies in science and mathematics and the elements of civil and mechanical and electrical engineering, all of which are essential if the railway engineer is to have a thorough grasp of his profession, that there is little time left for special studies in the field of railway engineering proper, such as signaling, brake equipment, railway accounting, locomotive design, etc.

Perhaps this difficulty might be solved by making the course in railway engineering a post-graduate after the regular course in civil or mechanical engineering; but here another difficulty is encountered. The salary to which the student can look forward, if he be lucky enough to finally land in an executive position a few years after graduation, will generally be too small to justify him in spending two years of time in post-graduate studies; unless, perhaps, he is fortunate enough to possess independent means, in which case he will probably choose some less laborious life work than railway management.

Probably the solution of the problem will be found in a compromise, by which the student in the proposed railway engineering school will spend three years on foundation studies and the fourth in such special instruction in railway work as his mind can grasp during that time.

We recently noted the accident statistics of the Interstate Commerce Commission and the pronounced stand taken in its annual report in favor of the compulsory introduction of the block system as a means of reducing the present disgracefully long list of train accidents due to collisions.

We learn that a pamphlet has recently been issued in which an attempt is made to defend the safety of travel on American railways, and to show that the boasted greater safety on English railways does not really exist. The following abstract of the contents of this pamphlet is given in the Wall St. "Journal" of Feb. 5:

Mr. Thompson reports that on all the British roads in 1901, the total mileage being 22,078, the number killed by reason of all class of accidents was 1,171, and the number of injured 6,740. He takes eleven Chicago roads, whose total mileage is 23,427, or a trifle more than that of all the British roads, and shows that the number killed during the last fiscal year was only 865, and the number injured 4,909, or much less than the casualties on the British roads. Mr. Thompson claims that mile for mile, fatalities are fewer on American railways than on European, if the fatalities to other persons than employees and passengers be taken into computation. Moreover, he claims that notwithstanding the installation of the block signal system on nearly 30,000 miles of the busiest railways in the United States this has failed to have any appreciable effect in reducing the casualties. He argues that the best physical means to prevent collisions is to increase the double track mileage, next to which may come the block-signal system, but above all he argues that discipline carried to the point where obedience to signals is involuntary, must eventually become the reliance of the American railway system.

For the sake of the reputation of American railroading we wish we could commend Mr. Thompson's statistics; but truth compels us to say that to compare statistics of accidents on the basis of mileage is the height of absurdity. If that were a fair basis then it were easy to condemn the management of the Pennsylvania R. R., for example, by showing that the casualties on its main line from New York to Pittsburg are perhaps ten or twenty times as numerous as the casualties on a similar mileage of railway located in some backwoods country district, where the density of traffic moved is not a hundreth part of that moved on the Pennsylvania's main line.

The Chicago systems taken by Mr. Thompson for comparison while unnamed, doubtless refer to the systems which radiate from Chicago to the north, west and south. A large part, the bulk in fact, of their mileage is made up of local branch lines carrying a light traffic, particularly of passengers, and the proportion of double track line is insignificant. The English railways with which comparison is made are very largely double track and carry the heaviest passenger traffic in the world. If their total casualties, mile for mile, were not greater than those on the granger roads of the West, it would be, indeed, marvelous.

We might analyze further Mr. Thompson's statistics; particularly with respect to the fact that he appears to be comparing total accidents on English roads with the limited classes of accidents of which the Interstate Commerce Commission collects statistics; but the whole basis of his comparison being erroneous, further criticism is unnecessary.

His statement that the block system has had no appreciable effect in reducing casualties can have no weight with any intelligent railway officer; and while many of them will be glad to adopt his advice to increase double-track mileage when funds are available, and will appreciate his suggestion that discipline of employees to obey signals is important, they are not likely to overlook the fact that prior to such obedience, fixed signals (or, in other words, the block system) must be put in place for them to obey.

THE UNUSUAL PREVALENCE OF TYPHOID FEVER IN 1903 AND 1904.

The years 1903 and 1904 will long be remembered in the sanitary history of the United States as bad typhoid years. The Ithaca and Butler epidemics have already been followed by a serious outbreak at Columbus and, apparently, by an even more serious one, relative populations considered, at Leadville, Col. Minor outbreaks have been of frequent occurrence during the last few months, and all the while such typhoid centers as Pittsburg, Allegheny and Philadelphia have been more than keeping up their bad records for endemic typhoid. Such happenings are all the more notable when following, as they do, an unusual campaign of education and of actual preventive measures against impure water supplies and their consequences. If only the records of the past were not so very deficient, perhaps we should find that, aside from the great epidemics, conditions of late had not been so much worse than formerly as would appear, since more serious attention is now being paid to typhoid fever than ever before and, at the same time, the public is more ready than ever to take alarm when an outbreak occurs. It appears, however, that seasonal and climatic conditions, such as low stream flows in ice-bound rivers and the sudden entry of accumulated filth into rivers and creeks, conspired to render typhoid fever far more prevalent than usual. When the mortality records for 1903 and 1904 from all parts of the country become available it will not be surprising to those who read the signs of the present time if it be found that typhoid fever has been pandemic. If we mistake not, it will also be found at the close of the current year that a great movement for improved water supplies in particular cities and towns, and a general movement for the protection of all water supplies in whole states, had been set on foot and made no mean progress. In addition, we may hope to see some little progress, at least, towards an extension of the proper registration of vital statistics in the non-registration states and cities, thus lessening the number of municipalities that are in the shameful condition of being liable to be overtaken at any time with a serious epidemic, and found entirely without means of ascertaining the fact until it has progressed so far as to render the original sources of infection beyond control.

Coming now to more specific facts, we desire to call attention to the special report, elsewhere in this issue, on the present epidemic of typhoid fever at Columbus, O., by Prof. F. H. Eno, M. Am. Soc. C. E., and also to several other reports, in this issue, on typhoid fever and allied topics.

Columbus has long been notorious for a dangerous water supply, a high typhoid fever rate, a defective system or a lack of any real system of sewage disposal and for dilly-dallying with the needed reforms after recognizing them and securing plans to put them into effect. The engineering department, we are pleased to say, has recognized the sanitary needs of the city and appears to have done all within its power to meet them. Nevertheless, Columbus has not seemed to be able to get beyond plans and reports.

In December, 1903, there were 40 cases of typhoid fever in Columbus, which seems to be about a fair average monthly record for the city. Early in January the number of reported cases of typhoid fever began to increase with alarming rapidity and by Feb. 5 about 1,000 cases and 50 deaths had been reported, the deaths for some five weeks exceeding the average yearly total for the past five years.

As to cause of this outbreak, it can only be said, as yet, that portions of the water supply have long been known to be polluted and that recent investigations have shown that sewage from the State Hospital for the Insane was being discharged into a creek at a point some two miles distant, by water, from one of the city waterworks intakes. The sewage was supposed to be flowing in another direction, but the possibility of pollution from this source, it is said, was pointed out some time ago by the State Board of Health.

River patrolmen are employed by the Board of Public Service, or by the water-works department under it, to prevent the pollution of the sources of water supply within the city limits, but an examination of Professor Eno's report and one of the appendixes thereto reveals no evidence that their services have been well utilized. So far as can be judged from the information at hand, the energies of these men were directed against the surreptitious dumping of garbage and night soil down the river banks, while no attention seems to have been given to private sewers, outhouses and other possible sources of constant pollution. Moreover, the men were on duty only 16 hours out of the 24, and one of the two day patrolmen devoted himself to the Olentangy River, not because water is taken from it, but because many people think it is.

Failure to patrol beyond the city limits has been explained, in part, by lack of legal authority on streams outside the city, but it appears that any city owning water-works really has authority "to prevent or punish any pollution of the water" for a distance of ten miles beyond the city limits.

It is not unreasonable to suppose that under the well-known conditions prevailing at Columbus the water-works, health and legal departments of the city would have left unutilized no legal power or physical possibility of discovering and abating every source of pollution of the water supply, whether from a state institution or a private house. Instead, no one seems to have known just what specific dangers existed and certainly no effective measures were taken to prevent the contamination of the water supply.

On Feb. 5 the raw Scioto River water was again turned into the mains. So far as our information goes, this course was warranted only on the assumption that the epidemic was caused by the sewage from the hospital named, which had then been shut off from the river since Jan. 16, or nearly three weeks. It is to be hoped that this assumption will prove true, and that another wave of typhoid fever will not sweep over the city.

Passing from the Columbus epidemic, brief notice may be given to the report on the situation at Waterloo, Ia., by Dr. Mack, Health Officer of that city. The most that can or need be said here is to point anew to the well-nigh utter helplessness of a city without a registration of deaths, to say nothing of one which lacks prompt reports from physicians for all cases of communicable disease. It is to be particularly regretted that Waterloo has no vital statistics of value, in view of the fact that its water is treated by mechanical filtration and that it is believed by many that relatively small mechanical filters are, as a rule, so carelessly operated and so stingily provided with coagulant, that they are not a safeguard against disease. Whether equal carelessness and danger accompanies small filters of the slow-sand type we cannot here take the space to discuss. For the benefit of the Waterloo filters, it can be said that no serious epidemic has yet developed in that

city, but the deficient vital statistics probably fail to reveal the gravity of the situation.

A particularly instructive occurrence at Lowell, Mass., last summer, has been briefly reported for this journal by Mr. George Bowers, M. Am. Soc. C. E., City Engineer of Lowell, Mass. Briefly, some valves interconnect the pure driven-well water supply of the city with the polluted Merrimac River supply of some of the large mills. This interconnection is designed to give the mills the benefit, when needed, of the fire pressure on the city system. Last summer one of the valves became stuck, when open during a fire, and the ordinary pressure on the mill system being greater than that on the city system, the latter received some polluted Merrimac River water. The effect of this accident is shown by comparative weekly typhoid statistics; the totals for nine weeks being 168 case in 1903, against 15 in 1902, and 13 in 1901.

Attention is invited to the statement, elsewhere in this issue, by Dr. A. C. Abbott, Chief of the Bureau of Health of Philadelphia, regarding the effect upon typhoid fever of the small amount of filtered water available in that city during the past year. It is difficult to pass upon this question, as Dr. Abbott points out, but apparently the districts getting the filtered water already show a marked reduction in typhoid fever, although many of their inhabitants spend large portions of their time in other parts of the city, where unfiltered water is still used. The need for filtration in the city as a whole is eloquently shown by the fact that in 1903 there were reported 8,701 cases and 957 deaths from typhoid fever. In view of such a record, the city is to be doubly congratulated for having well under way a number of filtration plants that, taken together, will afford it an adequate supply of pure water.

Accounts of some interesting typhoid outbreaks at and near Kittanning, Pa., follow the three last-named special reports, but they were received too late for comment here.

LETTERS TO THE EDITOR.

Another Low-Priced Engineer Wanted.

Sir: In your issue of Jan. 28, in which Mr. Yuille calls attention to a want advertisement that appeared in your columns, is also the following advertisement:

Resident Engineer, technical graduate preferred, capable of taking entire charge of railway construction; Central States; $75 and expenses. Address "Central," 1636 Monadnock, Chicago.

Of course there are lots of engineers (?) "capable of taking entire charge of railway construction" who will be glad to avail themselves of this chance.

Yours truly, H. S. M.

Angelica, N. Y., Feb. 2, 1904.

A Method of Thawing Dynamite.

Sir: In view of the trouble and frequent danger incurred in thawing dynamite, the writer feels that possibly the scheme herein described may be of interest to some readers of Engineering News.

The writer has tried hot sand, also the orthodox method of placing the frozen sticks in a tight vessel surrounded by hot water, and both, particularly the latter, are slow. In the case of the sand, the writer was kept in constant apprehension because, in spite of repeated warnings, it was used dangerously hot.

Immersion in hot water thaws the powder quickly and safely, but it also weakens it very materially and is a bad practice.

At the suggestion of an old quarryman the writer secured a large wash-boiler with cover and placed in it a tray of wire screen. After 3 or 4 ins. of water in the boiler has been heated to boiling, the dynamite is quickly piled on the screen, the cover replaced and a blanket thrown over it, the boiler having just been removed from the fire.

A few minutes' steaming serves to thaw the powder, which is loosely piled so as to admit free circulation, and if it is removed promptly before the oiled paper wrapping has become soaked through, it shows no weakness from the treatment.

The water is renewed frequently, as more or less grease from the wrappings and powder from broken sticks accumulate in it and might lead to accident. All winter the writer has used this method—which he has never seen in print—with considerable satisfaction, and, he believes, perfect safety. Sincerely yours,

Shirley C. Hulse, Jun. Am. Soc. C. E., Asst. Engr. in Charge of Cons., U. L. & P. Co.

Taughannock Falls, N. Y., Feb. 2, 1904.

(Our correspondent himself mentions one of the most dangerous features of thawing dynamite in the manner described, that is, the accumulation of liquid nitroglycerin at the bottom of the boiler. Where dynamite has been thawed by plunging the sticks into hot water the danger is much greater, for many explosions have occurred, due, undoubtedly, to the leaking out of the nitroglycerin and its accumulation at the bottom of the bucket. —Ed.)

A Simple Formula for Reinforced Concrete Beams.

Sir: I have followed with considerable interest the various discussions and theories of reinforced concrete that have appeared from time to time in the columns of Engineering News. The one thing that has made quite an impression upon me is the cumbersome methods given for finding the moment of resistance of a reinforced beam and the amount of metal required for the reinforcement.

I would like to present a method of obtaining these that can be used without solving any difficult equations, or remembering any complicated formulas. We will assume a beam of rectangular section, with reinforcement near the bottom, and let

b = width in inches,

d = depth in inches,

d_1 = depth of reinforcement below top of beam.

200 lbs. per sq. in. = ultimate strength of concrete in tension,

2,000 lbs. per. sq. in. = ultimate strength of concrete in compression, and

50,000 lbs. per sq. in. = minimum value of the elastic limit of steel used.

Then for a beam of plain concrete the ultimate moment of resistance in lbs. would be $\frac{1}{6} \times 200\ (bd^2)$, while to develop the compression value the ultimate moment of resistance would have to equal $\frac{1}{6} \times 2{,}000\ (bd^2)$. The steel must then carry the difference between these two values, or a moment equal to $\frac{1}{6} \times 1{,}800\ (bd^2)$, and this value divided by d_1, the moment arm of the steel gives the ultimate stress that the latter must carry. This stress divided by 50,000 lbs. gives the area of steel required. In designing, multiply the actual bending moment by the factor of safety and design as above, on basis of ultimate strength. This method calls for a trifle more steel than is given by the formulas of Mr. A. L. Johnson, M. Am. Soc. C. E., published by the St. Louis Expanded Metal Fireproofing Co. This, it would seem, affords something of a check on the correctness of the method.

I would like to make one request of the kindly critics who will feel obliged to tear this into fragments. It is that they will confine themselves in their discussions to regions within hailing distance of the earth, avoid infinitesimals of a higher order (as well as their kindred vermin of various kinds), and consider the question from the practical standpoints of accuracy and reliability as shown by comparison with such test data as they have on hand.

Yours truly,

Frank L. Batchelder, C. E.

675 28th St., Milwaukee, Wis., Jan. 23, 1904.

Some Questions Relating to the Design of Overtopped Masonry Dams.

Sir: In examining the stability of several masonry dams, I encountered a few questions to which I did not find the answer ready prepared.

The usual test seems to be to assume the water level at the crest of the dam, as in Fig. 1. The diagram of unit pressures is then a triangle, as shown, and the center of pressure is at ⅓ h.

But the question arose: What additional forces are imposed on a dam by a rise of water above its crest, as in Fig. 2? In this case, we have, as before, the effect of the water up to the crest represented by a triangle; but

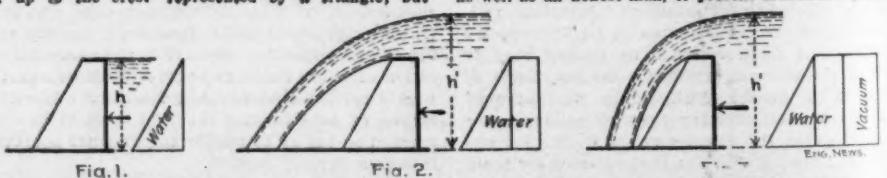


Fig. 1. Fig. 2.

DIAGRAMS ILLUSTRATING THE PRESSURE ON THE BACK OF THE OVERFLOW DAMS.

added to it the additional head of water flowing over the crest, and distributed uniformly over the entire back of the dam, this additional part being a rectangle; and the whole the trapezoid shown in Fig. 2. Not only do we have this additional pressure, but the center of pressure is raised, as well.

Thus far, I have assumed that the sheet of water falls freely, the air having perfect access to the under side of the sheet.

The next question was: What additional forces are imposed on the dam in case the falling water sucks the air out from behind the sheet? The degree of this effect is perhaps impossible to determine, as some air usually finds its way behind the sheet, but the worst possible effect is that in which we have a practically perfect vacuum over the entire depth of the down-stream face. In such a case we may consider the effect of the vacuum as that of an additional uniform pressure over the entire up-stream face, equal to one atmosphere. This is shown in Fig. 3.

In view of the fact that one atmosphere is equal to about 30 ft. hydrostatic head, and also of the uncertainty of the degree of the vacuum, it would seem well to watch this point carefully in designing dams; and either to design the down-stream face so that it will surely support the sheet at maximum flood, or else to supply a pipe the length of the dam, with openings under the sheet and leading to a high point on shore, in order to supply air under the sheet. Yours truly,

John C. Trautwine, 3d.

257 S. 4th St., Philadelphia, Pa., Jan. 19, 1904.

(Some of the points raised by our correspondent were discussed under "Letters to the Editor" soon after the failure of the Austin Dam, April 7, 1900. Pipes to admit air to overcome the effect of vacuum on the down-stream face of a dam were provided in a dam at Taftville, Conn., described on p. 472 of Engineering News of June 12, 1902, in the article on "The Hydraulic Air Compressor at Norwich, Conn."—Ed.).

The Attitude of Engineers Towards Water Meters.

Sir: At the close of the editorial note, in your issue of Feb. 5, upon the infrequency of recommendations by engineers for the installation of meters rather than the acquisition of additional water supplies, the following question is asked:

Perhaps the conditions at London are exceptional, but is it not more probable that the construction of works for an additional supply is more attractive to most engineers than the idea of installing meters, and that this accounts for the rarity of such recommendations as we have just noticed?

I believe that the rarity of such recommendations (if they are actually rare) is due to causes more creditable to engineers than the one you seem to suggest. It is often the case that an engineer is not called until the shortage of water is so threatening that he is really not warranted in recommending anything but an increase in the supply. He may be a strong believer in meters; he knows that in systems which are largely metered the consumption is universally less than in unmetered works under the same conditions. He also knows, however, that in most cases this has been due to the prevention of large consumption rather than its reduction after being once established, and that in those cases where a reduction has been secured it has been a work of some time. It is not practicable or desirable to carry out a general introduction of meters at once. It is with an engineer as with a doctor; if he is called in the early stages of the trouble, he can prescribe different remedies from those needed in the crisis of the disease. While personally I am a pronounced believer in the use of meters, I can well see how, with a municipality on the verge of a water famine, an engineer may hesitate to assume the responsibility of recommending the installation of meters as the only means of averting it. There is also the economic side to be considered. It often happens that the cost of increasing the supply will entail a smaller net annual expense upon the municipality than will the installation of meters. Then there is the practical side of the question. An engineer can demonstrate beyond doubt that an increased supply can be secured, but the reduction of consumption by meters is a matter to be supported by opinion, backed by statistics from comparatively few places where the conditions may or may not be similar.

Unfortunately, the whole meter question is misunderstood by, and unpopular with, many whose official action or influence is necessary to carry out the recommendations of the engineer. This should not deter him from giving his honest opinion, but it often leads him, as a practical, as well as an honest man, to present alternative plans for the selection of one of which others are responsible, while the engineer is generally credited with such selection. It seems to me unfortunate that an engineering journal which has so deservedly the confidence of the profession should give place, especially in its editorial columns, to an insinuation that reflects so severely upon the honesty of engineers in general, and I feel that it should not go unchallenged. Yours truly,

Freeman C. Coffin, M. Am. Soc. C. E.

53 State St., Boston, Mass., Feb. 6, 1904.

(If we used language that reflects, or seems to reflect, upon the honesty of engineers in general

we sincerely regret it. As a matter of fact our question, as intended, is a possible reflection on the weakness of human nature in general, rather than the honesty of engineers in general or particular. We are pleased to receive so prompt and straightforward a challenge in behalf of the profession, and will welcome further opinions on either side of the question.—Ed.)

How May Capital be Safely Invested in New Inventions?

Sir: Many of your readers have doubtless witnessed the rise and fall of new enterprises in the manufacturing field, the history of which might be tersely summed up about as follows:

(1) An inventor and a capitalist.
(2) A game of talk.
(3) Incorporation.
(4) Investment.
(5) Manufacture.
(6) More investment.
(7) No profits.
(8) Dissolution.

And yet notwithstanding this there are patents issued every week on new inventions that would pay a handsome profit if properly handled. Such patents should be bought and the articles manufactured by people who are already making similar articles; but only in exceptional cases will a manufacturer judge such improvements on his existing product to be worth the value that the inventor places on it. Hence the inventor inevitably drifts towards Wall Street with the result above tabulated.

Now, if capitalists wish to take flyers in such unknown fields, how are they going to safeguard their investments?

The answer is of course that they should first find out if the article is worth marketing, and then how to market it.

That sounds easy, but the real solution of such a problem requires an investigation and a management seldom given to such enterprises.

In the first place the opinion is required of a disinterested expert qualified by experience to accurately judge the value of the article. No man can do this with certainty who has not been directly engaged in the production of similar articles, or with such things as the article in question is to compete against and his experience should have been obtained with a successful concern. Further, one expert's opinion on a matter of large importance is not enough. Better engage two or three and let them criticise each other's work. If such care were taken by capitalists, nine millions out of every ten that are now sunk in fake patents would at least find other ways of getting lost.

Suppose, however, the experts decide the article is worth investing in, numerous other questions then arise:

How is the inexperienced capitalist going to find out how to make the business pay? How must the article be produced in order to be marketable? What amount of production is advisable for a start? How shall it be cheaply manufactured?

Shall it be made by contract in some existing shop? How shall such a shop be selected? Or, if the company decides to manufacture its own products, how shall the shop be designed? Again, how shall a general manager be selected, and who is going to manage him?

The most competent general manager that can be secured is liable to make one of two fatal errors; either he may wreck the company by unchecked extravagance, or, by yielding to demands for economy, cripple the plant for successful economical production. His position confines him to the shop, and it is not always expedient or desirable to give him full control of the finances.

It is, therefore, imperative that the invested capital should have a direct representative, competent to determine whether the product should be made in some existing shop, or to design a shop and direct the manager and determine whether the proper results are being obtained. If there is no such man among the executive officers or the directors, the company should find some one of well-known ability and employ him in a consulting capacity.

There is not a successful manufacturing company in existence that does not have a financial executive officer who knows every detail of the production, and most of these men have worked their way up from the bottom.

Expert accountants may tell a company where they are losing money, but they cannot tell the company how to make it; and in some instances they make the cost of getting the cost more than the cost of the production.

The modern machine shop manager or superintendent is recruited from the engineering department, or, retaining the title of chief engineer, he becomes the real manager of the shop, and as the engineering department is the base of all manufacturing and the source of all manufacturing information, this department is now generally recognized as the head of the shop.

This being the case it becomes necessary that the practical representative of the financial end of the company should be as competent an engineer as a manager.

In small cities and towns, where all executive officers are located at the shop, the conditions here cited do not exist, but New York shops are not located in office buildings, and New York capitalists do not locate on the Jersey meadows, hence capital and shop are separated by ferry boats and trains too far apart to keep in practical operative relation with each other. The result is that capital is either at the mercy of a mismanaged shop, or else the shop is at the mercy of the dictation of an inexperienced capitalist, hence the necessity of harmonizing the two by an active, responsible and competent representative of the capitalist. Chas. R. Pratt.

160 Fifth Ave., New York City, Jan. 18, 1904.

Data on the Shrinkage of Macadam Under the Roller.

Sir: I have noted with interest the article by Mr. J. Albert Holmes in Engineering News of Jan. 14, regarding macadam road construction along the Charles River, Mass., and especially the results as to shrinkage of broken stone in rolling; also editorial comments on the above in the same issue.

Mr. Holmes refers to some 6-in. macadam laid at Newton, Mass., in 1897, where it was found that loose stone rolled to 62% of the original depth—this being stated in the Annual Report of the City Engineer of Newton, for 1897.

The figure there given applies to some 65,000 sq. yds. of 6-in. work, and was obtained by means of a record of loads hauled and area covered. Considerable care was taken to arrive at the proper unit volume to use for single and double team loads, and it was felt that the results obtained were substantially correct for the given conditions of subgrade, weight of rollers, etc.

The writer was inspector on the Newton work above mentioned, and referring to the a note book covering this time, finds the following:

Kind of stone.	Thickness after rolling, in ins.	Depth loose kept up to.
No. 1's (tailings, largest stone).	3 to 4	5 to 6 ins.
No. 2's (medium size).....	3 to 2	5 to 4 ins.
Nos. 3's and 4's (small and dust)	⅛	¾-in.

These notes were the result of personal observation, and were recorded during the progress of the work, and before any total figures were obtained, but as you will see, they agree fairly closely with what was afterward found to be the case by computation. Numerous trials were made, several by means of canvas strips, in the way Mr. Holmes has described, to determine the amount of penetration of the stone into the subgrade, and this was carefully allowed for, as the payment for hauling the loose stone was per sq. yd. The writer accounts for the greater amount of shrinkage in this case, as compared to that cited by Mr. Holmes, as follows:

(1) The condition of the subgrade:

The Newton work was in connection with the widening of one of the main streets of the city, and over a considerable portion of this, the old surface material formed the subgrade of the new street. Taking it as a whole, the subgrade may well be said to have been rather more than ordinarily compact and unyielding. In the case of the Cambridge parkway the subgrade was all of gravel and very much more elastic.

(2) Heavier rollers were used on the Newton work, they varying from 12 to 20 tons.

While it is probable that in the usual case of macadam road construction the maximum shrinkage of stone in rolling is not over 25%, as you conclude, it seems to the writer that under conditions similar to the above, of heavy rolling, on a hard, unyielding subgrade, this may be considerably exceeded. Yours truly,

H. K. Barrows, Assoc. M. Am. Soc. C. E.

University of Vermont, Burlington, Vt., Jan. 18, 1904.

[Can any of our correspondents give data of shrinkage of soft rocks, such as shale, under heavy rolling? There appears to be no printed record of such shrinkage. In fact, shrinkage data of all kinds are scattering and not always consistent. There are three factors which should be clearly stated: (1) What the character of the subgrade is; (2) whether the "loose stone" includes also the binder or screenings; (3) what kind of stone was used.

On a sand subgrade the stone may be driven down 2 or 3 ins. under a 10-ton roller, the sand ascending for some 4 ins. into the voids of the stone. For the sake of uniformity of records, if for no other reason, the screenings should not be classed as part of the loose stone or ballast. We are at loss to account for the data of shrinkage of the No. 3 product, or screenings, as given by our correspondent; for the apparent shrinkage of screenings under the roller usually approximates 100%—that is, they disappear completely from sight into the voids of the coarse stone below. The weight of the roller is, of course, a factor in the shrinkage, although if the weight is not less than 10 tons nor more than 15 tons there appears to be little difference in the shrinkage of hard stone on a solid subgrade. A communication from Mr. Barrows since the foregoing was put into type explains the shrinkage of the screenings, as follows:

As you will see from figures given, it was intended to get 6-in. thickness of Nos. 1 and 2 stone combined, and as a matter of fact, the ½-in mentioned as thickness of screenings and dust, after rolling, was largely below the top of the layer of No. 2's, and gives, perhaps, a rough idea of how much the fine stone was compacted, in being forced into place.

It would be interesting to know the method used in measuring this ½-in. thickness after compression.—Ed.].

San Francisco Opinions on the Union Engineering Building.

Sir: I was instructed to notify you that at an informal luncheon in San Francisco on Jan. 28, 1904, the matter of a Union Engineering Building was discussed by fourteen members of the American Society of Civil Engineers, residing in or near San Francisco. The vote was unanimous in favor of co-operation. The undersigned were present: Arthur L. Adams, Frederick J. Amweg, H. de H. Carnrick, C. E. Grunsky, Capt. W. W. Harts, F. D. Howell, Marsden Manson, Chas. D. Marx, Franklin Riffle, O. H. Snyder, F. P. Stearns (Boston), J. H. Wallace, Frank S. Washburn (Nashville), Chas. B. Wing.

Very truly yours, Chas. D. Marx.

Stanford University, Cal., Feb. 2, 1904.

Opinions of Washington Members of the American Society of Civil Engineers Respecting The Union Engineering Building.

Sir: When the ballots for voting on the Union Engineering Building were received by members of the American Society of Civil Engineers in Washington, the local committee at once arranged for a meeting of the local members. This was held on Saturday evening, Feb. 6, and was presided over by Brig.-Gen. Alex. Mackenzie, Chief of Engineers, U. S. A. There were present 33 members and letters were received from four others who were unable to attend. A collation was served and during the course of the evening the entire subject of the engineering building was debated, with a view to aiding those present in coming to a conclusion as to the proper course to pursue in the casting of their individual votes.

As showing the tendency of feeling at the opening of this meeting, of the four letters received from those unable to attend, the sentiment of all was adverse to the proposition of the engineering building. Mr. Robert E. Peary, Civil Engineer in the Navy, and Arctic Explorer, wrote: "I am strongly opposed to the American Society of Civil Engineers becoming one of the constituent societies in the occupancy and control of the proposed union engineering building." Mr. W. M. Wallace wrote: "It is doubtful if segregation of allied societies or even allied industries always works to the good of the individuals, and situated as we are . . . . we do not need the expressed aid of any outside influence to carry out the provisions of our Constitution, ... and the loss of individuality which would be the result of such a union would be most harmful to our society." Col. Thos. W. Symons, of the Engineer Corps; Mr. Kort Berle, Structural Engineer, and Admiral P. C. Asserson, Civil Engineer in the Navy, wrote in a similar strain.

At the opening of the debate Mr. J. A. Quinton, a consulting engineer of the U. S. Reclamation Service from Los Angeles, Cal., and Col. A. M. Miller, U. S. A., in charge of the filtration plant, etc., in Washington, and Mr. Arthur P. Davis, Supervising Engineer of the Reclamation Service, from Arizona, made remarks in opposition to the project. Mr. Quinton, among other things said:

Would a man in moderate circumstances, but yet able to support his family comfortably in a small home of his own, give it up to share a better and more commodious establishment offered him freely, to be shared in community with three other families?

Mr. Davis said that, in his judgment, the present house is adequate during 364 days in the year, only on one day, that of the annual meeting, would a larger and more commodious establishment be desirable.

In spite of the prevalent adverse feeling at the beginning of the meeting, after the matter had been carefully discussed and information had been furnished on the other side, there developed a strong undercurrent of feeling favorable to the proposition. Several men, who had come to the meeting with their minds fairly fixed on casting an adverse vote, left the meeting, saying that as the proposition had been presented and in view of the facts submitted during the evening, they would vote favorably.

Mr. Elwood Mead, Director of the Society, explained to the meeting the feeling expressed at the annual meeting in New York and said that whereas he had, before attending that meeting, been opposed, he now favored the engineering building.

The most useful contribution in favor of the proposition was that submitted by Mr. Wm. H. Wiley, of New Jersey. Mr. Wiley's remarks were especially made with a view to showing the financial side of the proposition, and as he is a member of other proposed constituent societies, and the treasurer of the American Society of Mechanical Engineers, he was able to give data which made it quite apparent that the possibility of any or all of these so-

cieties being unable to meet their share of the expenses and thus throwing the whole burden back on the American Society of Civil Engineers was very remote.

Mr. H. M. Wilson, Geographer of the Geological Survey, spoke in favor of the co-operation and union of all members of the profession of engineering, regardless of their specialties as mechanical, civil, electrical or mining experts. He was in favor of casting his vote for the co-operation, provided the board of directors of the society, in whom he had confidence, found that the finances and the interests of the society will be safeguarded. The result will be that engineers visiting New York may be able to consult the libraries and discuss with individual specialists the many problems which they might have before them without the necessity, which they might neglect, of journeying over so great a city from the headquarters of one to those of the other of the now widely separated societies. Mr. J. F. Hayford and, finally, the chairman, Gen. Mackenzie, indicated preference for the union.

At the close of the meeting Gen. Mackenzie was elected permanent chairman of the local organization for the coming year and was directed to appoint a committee of three, who, in addition to himself, should formulate plans for a more permanent local sub-organization, and was directed to see that at least one other meeting of the local members should be held within the next 12 months.

H. M. Wilson.

Washington, D. C., Feb. 7, 1904.

A Division of the Carnegie Gift Suggested.

Sir: With due appreciation of the extraordinary liberality of Mr. Carnegie's offer, it is nevertheless easy to see that it would be more satisfactory to all concerned if the proposed donation were to be divided among the several organizations in whatever proportion Mr. Carnegie might desire, thereby leaving each, as heretofore, in absolute control of its own affairs.

There was no desire to form any kind of a merger before this gift was offered, and apparently there should be no such desire now.

It is altogether improbable that an objectionable condition would have been made, knowing it to be such, and possibly a suggestion that it is objectionable might be sufficient to remove it.

With all respect, therefore, it is to be hoped that the proposed donation in its present shape will be declined.

Yours truly,

John A. Fulton, M. Am. Soc. C. E.

184 La Salle St., Chicago, Ill., Feb. 1. 1904.

(No "merger" of the several societies is proposed. As for dividing the gift among the several societies, Mr. Carnegie is too good a business man, we apprehend, to be favorably impressed with the idea of endowing four separate engineering society buildings in New York city.—Ed.)

Reasons Against the Proposed Co-operation.

Sir: The offer of Mr. Carnegie as to the proposed Union Engineering Building is a munificent one. That it should, however, not be accepted on part of the American Society of Civil Engineers is a conclusion which hardly seems open to serious question by any one caring for the best interests of the society.

The society is well and beautifully housed; location, building and all machinery for effective work leave practically nothing essential to be desired. The building is not too small because once a year, perhaps, its auditorium may not hold all that come. There are other halls, among them one of the largest in the city, available and almost adjoining. For all regular meetings throughout the year the building is amply large.

The society is not a national one, only; like the Institution of Civil Engineers, and like no other, it is of all countries and is in its ideals a definite entity in the minds of trained engineers throughout the world. To merge the interests of such a body to any extent with those of others, however worthy, and though more or less co-related, would be to run the risk of impairing the force of its individuality.

Another side of the question develops which it is not agreeable to contemplate. It bears the semblance of coercion. Is the American Society of Civil Engineers by implication to be accused of defeating the whole project in refusing to accept, thus depriving the other would-be participants?

Shall we continue to be self-reliant, or are we to be led to believe that self-respect is pessimism, and progress the indiscriminate taking of what one can get?

Yours respectfully, W. H. Breithaupt.

Berlin, Ont., Feb. 6, 1904.

Who Would Manage the Building?

Sir: I made the following clipping from a Pittsburg paper of recent date:

NEW BRUNSWICK, N. J., Jan. 28.—(Special.)—Andrew Carnegie has notified the trustees of the public library at New Brunswick that he is opposed to permitting the board of aldermen of the city to use the basement of the library building for a meeting room. The board now leases a meeting room, paying $600 a year. The plans for the new Carnegie library building were drawn with a view to having the basement used as a board room, thus saving $600 to devote to library purposes.

The trustees of the library were about to offer the room to the city when it was suggested that Mr. Carnegie's wishes be consulted. He vetoed the project, although assured that the plan would not cause any encroachment upon the room devoted to library purposes. He says he wants the building devoted exclusively to library ends.

The question at once arose in my mind: Has Mr. Carnegie any reservation as to the uses of the projected Engineering Societies' Building, that has not yet come to the surface? If the above newspaper account is correct, it appears that the Library Building was designed with a board room, and that the trustees were acting in the purest good faith in permitting the aldermen to use that room for a consideration that would have purchased $600 worth of books or periodicals annually. It certainly appears like an economical stroke of business, and any illegitimacy is not readily apparent.

Can it be that in the case of the Engineering Building Mr. Carnegie retains any sort of censorship? Surely the several societies interested may be trusted to put the building to no objectionable or illegitimate uses. Still, is it not quite conceivable that some one of the societies might wish to entertain some visiting kindred society toward whom Mr. Carnegie might hold some feeling of disapproval or dislike, or that he might object to for reasons of his own, and that he might come thundering down with a veto? It seems to me this is worth consideration. For myself, I should not have thought of such a possibility had it not been for the New Brunswick incident.

Another point which I do not remember to have seen mentioned authentically, and that is the name of the building. Is it to be "The Carnegie Engineers' Building," "The Carnegie Union Building," or what? I am a very new member of the American Society of Civil Engineers, but hold as high a degree of pride in the society as do much older ones, and I do not want to see it barter any of its independence for a mess of potage, only to wake up some morning to find itself in the potage! T. H. L.

Steubenville, O., Feb. 5, 1904.

(To answer our correspondent's inquiry, so far as we are able, we may say in the first place that without a more authentic and detailed account of the New Brunswick incident than a newspaper correspondent's despatch, it would hardly be safe to form an opinion based upon it. In the second place, it would doubtless lie with the Executive Corporation to decide upon the name for the building as well as the details of its use. Mr. Carnegie, in his original written offer of Feb. 14, 1903, merely addressed it to the membership of the several societies, and said: "It will give me great pleasure to give say one million dollars to erect a suitable Union Building for you all, as the same may be needed." It is also of interest to note the following in the remarks of President Alfred Noble, at the annual meeting of the American Society of Civil Engineers, reporting the conference with Mr. Carnegie on Jan 18:

Mr. Carnegie showed great interest and anxiety as to the probable action of this society . . . . and the strongest desire to provide a suitable home for the whole engineering profession.

It may properly be added, perhaps, that in the case of Mr. Carnegie's previous large gifts to institutions, such as the Carnegie Institution for Scientific Research, he has shown no disposition, so far as we are aware, to interfere with the details of administration and management.—Ed.)

The Union Engineering Building.

Sir: An argument advanced to me by a prominent member of the American Society of Civil Engineers against the acceptance of Mr. Carnegie's offer to erect a Union building for the four National Engineering Societies is that it will be another "Carnegie Monument;" that Mr. Carnegie will receive all the credit and the building will be known by his name, while as a matter of fact the real success of the venture is dependent, not upon the building, but upon the subsequent efforts of the constituent societies, which will be called upon to raise not only a large amount of money to buy the ground upon which the building is to be placed, but also will be responsible for its maintenance.

Mr. Carnegie has had unusual facilities for amassing a fortune and many men have contributed to that fortune their brains and energies, and perhaps to no other factor is Mr. Carnegie more indebted than to engineering science. None know this better than Mr. Carnegie himself. Mr. Carnegie, therefore, influenced by a broad spirit of philanthropy and generous recognition of the debt which modern commercialism and vast fortunes owe to engineering science, should be more interested in presenting this gift to the Engineering Societies of the United States, than the constituent societies are in receiving it, and upon the completion of the building the knowledge of an act well performed will be Mr. Carnegie's sufficient reward. While I have seen no authoritative statement concerning the relation which Mr. Carnegie's name is to bear to the completed project, it still seems to me, in thinking over the arguments used by me against the project, that if assurances were sought from and given by Mr. Carnegie or those who represent him, that this building when completed will in truth be a Union Engineering Society Building, known and read of all men upon its face as such, and not, as it is now reported, "only another Carnegie monument," then one of the most potent arguments against the acceptance of this gift will have been overcome.

Another argument used among the societies themselves is the inequalities which at present exist among them. The American Society of Civil Engineers is at present admittedly in a position superior to any of the other national engineering societies, both as to numbers and finances. This is due, perhaps, to the fact that those branches of engineering science coming more particularly under the caption of "civil engineering" are more advanced than the other branches of the profession. Whether this will remain so in time to come no one knows. It may be that electrical or mechanical engineering are destined by invention or otherwise to eclipse in importance that of civil engineering. In this age of discovery and progress he who is on the top to-day may be last in the race to-morrow. Jealousies, then, among the societies are petty, too petty to have a place in this argument, and too petty to influence broad-minded and thinking men. Adjustment and reciprocity are to be the key-note of the future, and none should more readily adopt these measures than engineers among themselves.

It is true that the American Society of Civil Engineers seems to have less to gain by the proposed alliance than the other organizations, but this may be only a temporary and surface indication, and I cannot conceive a probable condition in which it can lose anything by the affiliation. It seems to me, on the other hand, that this society, with its present admitted superiority, is afforded an opportunity to manifest the magnanimity which should pervade a scientific body of this kind, and to do that which unquestionably will tend to raise the standard of engineering as a profession. Very truly,

Alexander Potter, Assoc. M. Am. Soc. C. E.

143 Liberty St., New York City, Feb. 1, 1904.

(Mr. Carnegie has offered his gift absolutely without conditions. There is no reason to suppose that he has any other object in view than the exercise of the broad spirit of philanthropy, to which our correspondent alludes, and the desire to benefit and increase the reputation and prestige of the engineering profession, through whose work so great a part of his fortune has been amassed. —Ed.)

A Negative Vote and the Reputation of the Engineering Profession.

Sir: As you have opened your columns to correspondence relative to the matter of the Carnegie Engineering Building and the American Society of Civil Engineers, I will take advantage of the opportunity to say a few words on this subject.

For on outsider to discuss this matter may seem to some like impertinent interference in the domestic affairs of a body which ought to be left to settle the matter for itself; but I cannot take this view. It should be considered not only that on the decision of this society hangs the future of this entire project of Mr. Carnegie, but what is of far more importance, the good name of the engineering profession and the appearance before the public and the world which a negative decision would create.

The writer must confess to having a tendency toward that hated thing called "pessimism"—or, in other words, to an inclination to take a conservative rather than a roseate view of new projects and to make ample deductions for unexpected contingencies; but having read all of the arguments thus far presented against the proposed co-operation of the societies in the union building, he must confess he is absolutely at a loss to discover any objection that can be regarded as serious against the proposition in general. The objections as put forward by the Board of Direction of the society relate almost exclusively to the proposed methods of carrying out the project, which have not yet been decided upon, and which the society would necessarily have a hand (probably the largest hand) in deciding.

It is evident, however, that there is a strong line of division in the society on the question itself which is not based upon these particular objections at all, but upon a sort of "I-am-holier-than-thou" feeling toward the other societies on the part of a large proportion of the membership. This comes to the surface at every turn of the debate, but it is by no means a new sentiment.

It will be remembered that twenty-five years ago when mechanical engineers, members of the society were struggling for recognition of their end of the profession, they were met with the reply that a mechanical section was not necessary for the reason that civil engineering included mechanical engineering as a part of itself. Not-

withstanding this the mechanical members were simply crowded out by those interested in non-mechanical engineering. The latter were in the majority, and thus the others were obliged either to sit still and look on, or else "flock by themselves." They chose the latter alternative, and formed the American Society of Mechanical Engineers.

The tacit assumption above mentioned existing in the society which is somewhat to the effect that "We are It and no one else is," has given from the beginning until now a certain unavoidable and unmistakable hauteur to the demeanor of the American Society of Civil Engineers toward other engineering societies, as is indeed expressed in the arguments of the Board itself:

> The experience of the Institution of Civil Engineers of Great Britain indicates that a certain amount of exclusiveness and conservatism engenders in the members pride in the organization and solicitude for its welfare, and begets in the public a reliance upon its character which might be jeopardized by such an association with other organizations having different histories, aims and traditions, . . . The result would be a loss of prestige instead of a gain.
>
> This society stands for certain principles which individualize its character, among which is the fact that the term "Civil Engineers" used in its title comprehends military, naval, mining, mechanical and electrical engineers, architects and marine architects. . . . To be housed in the same building with other societies in which different organizations would be shortly termed "civil," "mechanical," "electrical," "mining," would lead to a restriction of the proper meaning of the name of this society in the popular estimation, thus detracting from its dignity and destroying its individuality.

The argument of this wing of the society against cooperation with the other societies seems to be embodied in the letter of Mr. Geo. D. Pickett, of the extreme right. Mr. Pickett, recognizing the important nature of the question, states himself decidedly opposed to the acceptance of the offer and "for the following considerations." One expects here to find at last the real reason for these views, but what one actually does find is nothing but a short synopsis of the society's history. One is at a loss to understand what possible relevancy these facts can have to the question at issue. The letter concludes with the surprising suggestion that this society should take out their pro rata portion of Mr. Carnegie's $1,500,000 donation for the new union building, and simply pocket it for enlarging their own headquarters or for such other use as they see fit.

Surely this last suggestion is one which reflects on the horse-sense of Mr. Carnegie, and of the society as well! It was not the only one of like nature made at the meeting. One member offered a resolution of inquiry (which was properly voted down) into the finances and conditions of membership of the other societies, which cannot be considered as other than a direct insult to the other societies, though fortunately the society at large did not make itself responsible for it. Other unfair attempts were also made to prevent the acceptance of the offer, as by requiring a two-thirds vote and by appending to the ballots a statement that a majority were opposed to the project.

This spirit on the part of the civil engineers certainly shows a lamentable (were it not so serious it would be laughable) state of mind among the different branches of a single profession having practically every interest in common. It is not time for the civil engineers' society to begin to recognize that they are not "the whole thing," and that whatever the name "civil engineering" may once have stood for, it now stands, in technical circles, for one branch of engineering only, as indeed does the society itself in fact, if not in theory.

The members of this society had once the opportunity to retain all of the others within the fold by creating suitable sections and giving representatives of these branches due representation in the society. Having chosen the other course, they certainly ought not to wonder at or object to the formation of separate societies to represent these special branches. They ought, moreover, to recognize the fact that the immense broadening of the field of engineering since their society was formed has made it quite as possible for one society to claim to represent all its branches as for one man to claim representation in several professions, and that a man who builds bridges and buildings cannot longer expect to claim expert knowledge of engines and dynamos, or vice versa.

I do not by any means attribute these sentiments of exclusiveness to the society at large, or even to a majority of its members; on the contrary, I believe the old and conservative element of this society, which holds these views, to be rapidly giving way to a younger and more progressive element which has grown up as brothers-in-arms with the other engineering societies and their members. I believe that the day will be carried by these latter for the Carnegie proposition; but I wish to say, with the greatest earnestness of which I am capable, that a decision to the contrary, on any such grounds as have been put forward, by the most enlightened citizens of the most democratic country on earth will be a lasting disgrace to the profession, besides being a cause of world-wide ridicule.

The writer has been led to present these thoughts not from any desire to meddle, but from a sense of personal concern in the matter, as a member of the broad engineering profession, who takes a just pride in its prestige and welfare.

George W. Colles.

Milwaukee, Wis., Feb. 1, 1904.

The Business Aspect of the Union Engineering Building.

Sir: The published statements of the Board of Direction of the American Society of Civil Engineers do not deal with the financial and business features of the proposed Union Engineering Building as fully and as much in detail as seems desirable for a clear understanding of the aspect of the enterprise, and the discussion of the project at the annual meeting of the society, disclosed the fact that there is among the members a good deal of misunderstanding and misinformation on this point.

While the business side of the proposed scheme is not the most important one, it is nevertheless worthy of careful consideration. The prosperity of the society is due in no small degree to the careful, conservative and successful management of its business affairs. It has now attained a position financially where it may look forward to the possibility of extending and broadening its work, thereby enlarging its usefulness to the profession and to its membership. It is natural and proper that its members should enquire with some anxiety what effect the proposed change will have upon the future business results of the society; and in order that they may vote intelligently in the ballot now pending, it is necessary that they should have the fullest possible information.

I have made an effort to get at the facts and to reach intelligent conclusions upon this matter, and whether these conclusions be right or wrong, a discussion of them may be helpful to other members in deciding how they shall vote upon the main question; "Shall the American Society of Civil Engineers become one of the constituent societies in the occupancy and control of the proposed Union Engineering Building under the terms outlined by the Joint Conference Committee?" What I shall here say is not intended as an argument for or against the general proposition, upon which I have not yet decided how I shall vote. Every member of the society doubtless desires that this important matter shall be decided strictly upon its merits, and to vote intelligently we need all the information obtainable.

It seems to be definitely settled that beyond the necessary preliminary arrangements the relation between the Engineering Societies proper and the Engineers' Club will be one of entire business independence of each other. In the design, construction and management of the two separate buildings, as well as in the financial obligations incurred, there will be no connection between the club and the corporate body acting for the Engineering Societies.

Members of the Engineering Societies, as such, are therefore interested in the Union Engineering Building alone. The proposition before them may be briefly outlined thus:

1st. Mr. Carnegie has offered to donate a sufficient sum to construct a commodious building for joint occupation by the four Engineering Societies.

2d. To facilitate the carrying out of the enterprise, Mr. Carnegie has secured the necessary real estate upon which the proposed building is to be erected, and he will convey this property to the four societies, or a corporation representing them, at cost to him.

3d. Mr. Carnegie's proposition is therefore to *donate* the cost of the proposed building, and to *sell* to the societies the land upon which the building is to be erected.

4th. For the purpose of holding and administrating both the land, and the building fund to be thus acquired, a *corporate body* is to be created which will act as the trustee of the four societies, and in which each society will have an equal representation and exercise an equal control.

5th. This corporate body will acquire from Mr. Carnegie title to the real estate, and will receive from him and administer the fund donated to erect the building. It will determine the plans for, and will have charge of the operation of the building after completion.

6th. To pay Mr. Carnegie for the real estate upon which the house is to be erected, the executive corporation may issue corporate bonds or certificates of indebtedness bearing interest at 4%, redeemable upon six months' notice. Each of the four societies may purchase and hold an equal amount in value of these bonds or certificates; or with the consent of the corporation any one society may purchase and hold an additional amount. It is not distinctly so stated in the general plan adopted by the Joint Conference Committee of the four societies, but, presumably, any of the bonds not taken up by the societies may be sold to other parties, though it is clear that the plan contemplates that the whole issue shall eventually come into the possession of and be held in equal amounts by the four societies, and it is stipulated that no one of the societies shall sell its bonds except to the corporation. The provision that the bonds shall be redeemable on six months' notice will enable the corporation at any time to regain control of any that may be sold to outside investors.

7th. Each society will be allotted, by the executive corporation, space and facilities adequate to its needs, and each shall be assessed its share of the cost of operation and maintenance of the building in proportion to the space occupied by it. Any surplus room not needed by the societies may be assigned to the use of other scientific associations, they to pay a pro rata share of the expense of operation and maintenance of the property.

8th. Mr. Carnegie has indicated that he will, if necessary, donate as much as $1,500,000 for a building fund, but this sum, it is understood, is to cover the cost of erecting both the Union Society Building and the Engineers' Club Building, and a division of the sum between the two buildings has not yet been made. It is conservative to assume, however, that at least $1,000,000, and probably more, will be devoted to the Union Society Building.

The above is believed to be a correct but brief outline of the project, divested of unimportant details.

What would be the financial position of the American Society of Civil Engineers should it elect to join the three other Engineering Societies in the enterprise; what obligations would it assume; and what would probably be the amount of its share of the expense of operation and maintenance of the building?

Mr. Carnegie paid for the five lots fronting 125 ft. on 39th St., upon which the building is to be erected, the sum of $517,000, and he is holding the property for the societies. It may be safely assumed that the ultimate cost of the property to the societies will not exceed $600,000. Assuming that 4% bonds are issued by the executive corporation to this amount, to pay Mr. Carnegie for the property, the American Society of Civil Engineers would be entitled to and would be expected to purchase and hold one-fourth of the whole, or $150,000 worth of the bonds at par, upon which it would receive 4% interest. The investment would be absolutely safe and secure, since the bonds would be a first lien, not only upon the real estate, but upon the building erected thereon. The real estate is reasonably certain to largely increase in value. This increase would offset materially the depreciation, with age, in the value of the building, so that the value of the whole property is not likely, for a long period at least, to fall much below its original cost. No debt would be incurred on account of the building, which is to be donated by Mr. Carnegie.

Each of the other three societies would doubtless eventually purchase and hold a like amount of the bonds. In the remote contingency of any one of the societies going out of existence or defaulting, the bonds held by it could be purchased by the other societies, or could be sold to outside investors. As the bonds would carry no voting rights, outside ownership could not affect the control of the property, which is to be perpetually vested in the executive corporation composed exclusively of the representatives of the societies.

It would seem, therefore, that in so far as the investment in the real estate is concerned, the societies would assume no dangerous obligations nor would they be subject to any possible hazard.

The question of the disposal of the present society house, in case the society should go into the new Union Building, must be considered. The original cost of the building and the ground upon which it is erected was $191,730. We have no data as to the present value of the property. Notwithstanding the natural depreciation of the building, it must be remembered that the cost of building has advanced very greatly since the house was erected and its market value is probably greater to-day than its original cost. The value of real estate in the vicinity has greatly increased and the market value of the lot to-day is probably double what was paid for it by the society. Two hundred and sixty thousand dollars is probably a conservative estimate of the present value of the whole property, and it ought to find a ready purchaser at $250,000. The location is an attractive one and the house is readily adaptable to the use of other societies, art associations, or clubs. It would doubtless have to be sold upon part payment of cash, the balance being secured by mortgage, and drawing interest. But it should not be difficult for the society to favorably finance the transaction in connection with the purchase of the bonds of the Union Building.

While the title to both the building and the real estate of the Union Engineering Building would be in the Executive Corporation, it may be assumed that the owners of the bonds would not only control but practically own the whole property, the original cost of which will be not less than $1,600,000, and the $150,000 worth of bonds owned by the American Society of Civil Engineers would thus have an actual value of $400,000.

The assets of the society, excluding library, furniture, etc., would be:

Value of bonds purchased and held....	$400,000	
Value of present house and lot.....	250,000	
		$650,000
Less cost of bonds purchased.....	$150,000	
Less mortgage debt on present property.	55,000	
		$205,000
Net assets.....		$445,000
The present net realty assets of the society are:		
Value of present property.....	$250,000	
Less mortgage debt.....	55,000	
		$195,000
Showing a gain in assets due to entering the Union House project of.....		$250,000
Out of the proceeds of the sale of the present property at		$250,000
The society would pay for bonds.....	$150,000	
And its mortgage debt.....	55,000	
		$205,000
Leaving a balance to surplus account of		$45,000

This sum, if invested at 4%, would yield annually $1,800, which could be applied to meeting the operating expenses of the society.

There is another consideration that must be taken into account. It is evident that the present society house will soon become too small for the needs of the society. In building it, provision was wisely made for adding two or more stories to its present height. Two additional floors, on one of which a larger auditorium could be provided, would probably supply the needs of the society for many years to come. But the cost of adding the two stories must be met by the society. I have no estimates of the cost of this addition, but the new construction, together with the changes that would be necessary in the old part of the building, would probably cost not less than $50,000. The society will undoubtedly be able to meet this expense, when it shall be necessary, but the addition to the real estate investment that would result must be taken into account.

So much for the *investment* features of the enterprise. It only remains to consider what effect the change from the present society house to the Union Engineering Building would have upon the ordinary receipts and expenditures of the Society.

Unless it can be shown that the change of location, or conditions attendant thereon, would affect the present prosperity and regular growth of the society, its receipts would not be either increased or decreased because of joining in the Union Building.

Of the ordinary expenditures, only those items would be affected which relate to the operation and maintenance of the Union House, of which the society would be called upon to assume and pay one-fourth.

Reliable data for estimating the cost of operating and maintaining such a building as the proposed Union Engineering House, devoted to similar uses, are not at hand, and seem difficult to obtain.

Obviously a building having one or two floors devoted to auditoriums that would only be used occasionally, with a considerable part of the remaining space used for library and storage purposes, the balance being used for the executive offices of scientific societies, would cost very much less for operation per unit of space, than would a crowded office building.

The estimates of the cost of operating the Union Engineering Building, given by "Member" on page 109 of last week's Engineering News, seem to assume that the cost would be about the same as if the building were a busy downtown office building, since the figures seem to agree very closely with those before me giving the actual cost of operating an office building of approximately the same size. A number of the items of "Member's" estimate are obviously wrong: Thus the cost of elevator and hall men is estimated at $3,172. If, as would doubtless be the case, the auditoriums were located upon the first or second floors, only one, or at most two elevator cars would be required, and not more than four operators (and no hall men) would be needed. The average pay of these operators would not exceed $10 per week, or $40 per week for all, and their pay would amount to $2,080 per year. Again, an engine room pay roll of $107 per week would be gross extravagance in such a building, and $6,000 worth of coal would not be required.

Comparisons based upon the cost of operating the present house of the society are unsatisfactory because of the great discrepancy in the sizes of the two houses, but such a comparison is not without interest. According to the last annual report of the society, the cost of operating and maintaining its house was as follows:

Maintenance of house	$542.47
Heat, light and water	1,242.14
Caretaking	1,794.92
Insurance (not separately stated)	.....
	$3,579.53

The house has, excluding basement, four floors, and is built on a lot 50 ft. front by an average depth of 110½ ft. The gross floor area is 110½ × 50 × 4 = 22,100 sq. ft., and the cost of operation and maintenance is therefore 19.2c. per sq. ft. of gross floor area. (I use the gross floor area for comparison because the net floor area of the proposed Union Building is not yet know.) The Union Engineering Building will be erected on lots having a total area of 125 ft. × 98¾ ft. = 12,344 sq. ft., and if built ten stories high, above basement, as proposed, the gross floor area would be 123,440 sq. ft. At 19.2c. per sq. ft. cost of operation and maintenance would be $23,700.48.

The new building would require elevator service, while no elevators are used in the present building, though they will become necessary should two stories be added to the building. On the other hand, some expenses as of heating and lighting, are materially less per unit of space, in large than in small buildings, and this should to some extent counterbalance the cost of operating the elevators.

For the reasons given above, and from a careful examination of other data before me, it may, I believe, be safely assumed that the cost of operating and maintaining the proposed Union Building would not exceed, and would probably fall below $25,000 per year. If the American Society of Civil Engineers should occupy one-fourth of the building, its share of the cost of operation should not, therefore, exceed $6,250.

It must be observed, however, that if the society should occupy one-fourth of the new building, it would have a gross floor area of $\frac{123,400}{4} = 30,860$ sq. ft., which is about 40% more than the gross floor area of the present house, and is roughly equal to the present house with two stories added. While the society does not need additional room immediately, it will need it before very long, and it would doubtless be wise to provide for and occupy it at once, when the new building would be ready for use.

Disregarding, however, this additional space, the operating expenses would probably be increased at once by the difference between $6,250 and $3,579 (the cost of operating the present house), or $2,671. To partly meet this, the society would have the interest on its surplus fund, $1,800, leaving a balance of $871 as the probable net increased running expense should the society join in the Union House. Whether this could be met by allowing other scientific societies to use the auditorium upon paying therefor a part of the expenses, is at least doubtful.

The above estimates are based upon the assumption that the house would be wholly occupied by the four Engineering Societies or by other scientific organizations, each of which would assume and pay its share of the total operating expenses. It seems reasonably certain that this would be the case, but prudence requires that we shall consider the possible contingency that a part of the house might not be occupied, and the far more remote contingency that some of the joint tenants might default upon payment of their share of the expenses. In either case the whole expense of operation would have to be borne by the paying tenants, and there is undoubtedly a possibility that the American Society of Civil Engineers might thus be saddled with burdensome operating expenses, but the *probability* of this seems so remote as to be practically negligible.

To sum up briefly: (1) As an *investment* the Union Society House would be advantageous to the American Society of Civil Engineers, and to join in the enterprise would be a perfectly safe business transaction. (2) The *operating expenses* of the society would *probably* be increased, and *possibly* might be so largely increased as to check its prosperity and impair its usefulness.

I have tried to state the facts and the reasonable deductions therefrom fairly in the light of the information available in the short time at my command since taking the matter up. In the absence of a full statement from the Board of Direction, relating to the business side of the enterprise, which I had expected and hoped for, I have endeavored to supply the deficiency for my own information. If I am in error on any point, I hope the discussion of the matter, in the technical papers, and otherwise, will bring out the truth. Let us understand the facts as fully as possible, and then vote intelligently and dispassionately upon the whole question, realizing that the result of the ballot may be epoch-making in the history and future success of the society.

S. Whinery.

95 Liberty St., New York City, Feb. 6th, 1904.

Notes and Queries.

In our issue of Jan. 28 we published a report relative to the fall of a concrete arch under construction over Cahokia Creek, Ill., due to the failure of the falsework before the concrete had set. We are informed by the contractors for the work, Messrs. Yawger & Battefeld, of Indianapolis, that the accident which occurred, and from which the report originated was a mere trifle. The forms supporting a buttress yielded slightly and a few cubic yards of green concrete slid out of place. The forms were rebraced and cleaned and new concrete placed in a few hours at a trifling cost.

EFFECT OF FIRE IN AN OFFICE.

The accompanying cut represents the effect of a hot fire in an office in the Masonic Temple, Chicago, on Jan. 25. The building is a fireproof office building, and the fire extended but little beyond the office in which it started. It will be seen that considerable damage has been done to the hollow-tile flat arches of the floor above, the bottom face and interior flanges being broken, while the flanges of the steel I-beams are exposed by the breaking away of the tile protection. This condition does not extend all over the room, but is of such extent as to require extensive repairs. The plaster ceiling was almost entirely stripped from the tile.

RESULT OF FIRE IN AN OFFICE IN THE MASONIC TEMPLE AT CHICAGO.

The partitions were of plaster and wire netting on wooden studs, and these studs were so charred that it was necessary to pull down the partition.

THE TYPHOID FEVER EPIDEMIC AT COLUMBUS, O.

By Prof. F. H. Eno,* M. Am. Soc. C. E.

In response to a request from Engineering News, I have prepared a statement of the conditions leading up to and at present pertaining to the epidemic of typhoid fever now prevailing in Columbus.

To arrive at a clear understanding of the conditions it will be necessary to briefly outline the water supply system.

THE COLUMBUS WATER SUPPLY SYSTEM.

Columbus is now supplied with water from two pumping stations. The main station, known as the West Side pumping station (see map, Fig. 1), is located in the northwestern portion of the city, at the confluence of the Scioto and Olentangy rivers. The other station, known as the East Side pumping station, is located in the eastern edge of the city, upon the banks of the Alum Creek.

*Assistant Professor of Civil Engineering, Ohio State University, Columbus, O.

The West Side pumping station was originally established in 1871, pumping from a well 20 ft. in diameter, and drawing water from a filtering chamber or conduit 256 ft. long. In 1877 the present system of filtering galleries was begun. These galleries consist of brick and cast-iron conduits, 3½ ft. in internal diameter, and laid in water bearing gravel, 15 to 30 ft. below the surface of the ground. The brick galleries were the first laid and were constructed of one ring of brick, with small openings left between the bricks in alternate courses in the under half of the conduit, as shown by Fig. 2. The main filtering gallery passes westerly from the works beneath the bed of the Olentangy River to a point on the Scioto River 5,715 ft. by the conduit line from the pumping station. This main chamber was reported finished in 1880. A branch extension of the same size and construction was built in 1883 for a distance of 1,650 ft. in a southwesterly direction, passing beneath the Scioto River to the low lands south of that river. In 1885 another branch was constructed north for 1,931 ft., having the same dimensions. From this system of nearly 9,300 ft. of 3½-ft. filtering galleries, 5,000,000 gallons of water was being pumped daily in 1885. Notwithstanding this extensive filtering chamber, from time to time it was necessary to take more or less raw water directly from the Scioto River through an intake conduit at the western end of the main conduit. The Scioto River water has always been considered dangerous. In order to supply the rapidly growing city, the East Side pumping station (Fig. 1) was erected and began service early in 1891, pumping water from a well 25 ft. in diameter and some 40 or 50 ft. deep, into which flowed 32 6-in. wells, driven through water-bearing gravel, to an impervious stratum 60 or 65 ft. below the surface. The distribution system of water pipes is common to both pumping stations.

The city rapidly outgrew, in its demands for water, these two sources of supply, and was again compelled to take raw water both from the Scioto River and Alum Creek. In 1897 the West Side station furnished an average of 7,689,500 gallons daily, and the East Side station 5,806,000 gallons. In 1897 and 1898 additional filtering galleries were added to the West Side station by the construction of 3,550 ft. of 3½-ft. cast-iron conduits; part of it paralleling the old brick conduit to furnish safe transmission to waters collected in that old conduit, in case of collapse occurring, to which it was quite liable, and indeed which has happened several times previous to 1898. The other portion branched off and extended for a considerable distance along and beneath the bed of the Scioto River. Nevertheless, with all this exploitation of the water-bearing gravel beds of the Scioto, Olentangy and Alum Creek basins, during dry seasons recourse was necessary to the raw river water. It has become plainly evident to those who have studied this question that the city has long since reached its limit of obtaining water from these two underground sources. In extreme dry seasons, even the Scioto has been drained to a dry bed in order to furnish the demands of the city. Under such conditions, if a conflagration were started the city would be placed in dire straits. Since 1893 several expert engineers have been called to examine and report briefly or more or less extendedly upon further sources of water supply for Columbus. The majority, if not all, of these experts have recommended: (1) Storage upon the Scioto as the source of supply, and (2) the necessity of purifying the supply thus obtained. The people have been warned time and again, both of the inadequacy of the present supply and of the danger of using the unpurified river water; but with surprising apathy the mass of the people have refused to produce the necessary funds for obtaining and purifying a proper supply and have condemned and actually blocked, by legal proceedings, any steps to so procure a supply. It is not only the mass of the people who have used measures of obstruction, but also and especially politicians and even occasionally high city officials. There is an ordinance before the city council now, proposing to appropriate $585,000 for the construction of a dam upon the Scioto River for storage purposes.

When this dam is built, it is the purpose of the authorities to proceed immediately and construct a purification plant, thus giving Columbus an adequate pure water supply. It is sincerely hoped by those who see the absolute necessity of hastening action that nothing will intervene to prevent the completion of the plans within the next two or three years. This gives a sufficient history of the supply to bring it up to date.

PRESENT ADMINISTRATION OF THE WATER SUPPLY.

Because it has been necessary, during the last few years, to take raw water from the Scioto River almost continually river patrolmen have been appointed, whose duty it is to patrol the Olentangy and Scioto River banks and prevent or report upon any pollutions that may occur along the rivers. These patrolmen are under the control of the Board of Public Service. Four such men have been employed at the West Side station for several years. One day man patrols the Olentangy to the northern limits of the city and the other the Scioto River to a point about four or five miles above the water-works.

Two night men patrol the Scioto River, only, to Grandview Ave., a point about 1½ miles above the water-works. Under the ordinance and laws by which these men are appointed, the Board of Public Service considers that the Board and the river patrolmen have no authority to police small streams discharging into the rivers and no authority along the river except over the immediate banks thereof. (See Appendixes I. and II.—Ed.)

Recently, the West Side pumping stations has been furnishing an average of 11,243,000 gallons daily to the city. Probably from 3,000,000 to 4,000,000 gallons of this supply has been raw water taken directly from the Scioto River. The West Side station is located at an elevation of about 40 ft. above city datum and is pumping water against a head of 160 ft. The East Side station is located upon an elevation of 70 ft. above city datum and pumps against a head of 126 ft. Upon the large map, Fig. 1, a line is drawn showing the approximate location of the line dividing the water supplied from the East station from that supplied by the West station. Of course this line fluctuates back and forth to some extent, due to the slightly varying pressures at either station and to sudden large drafts that may be made upon the mains on one side or the other of this supposed dividing line.

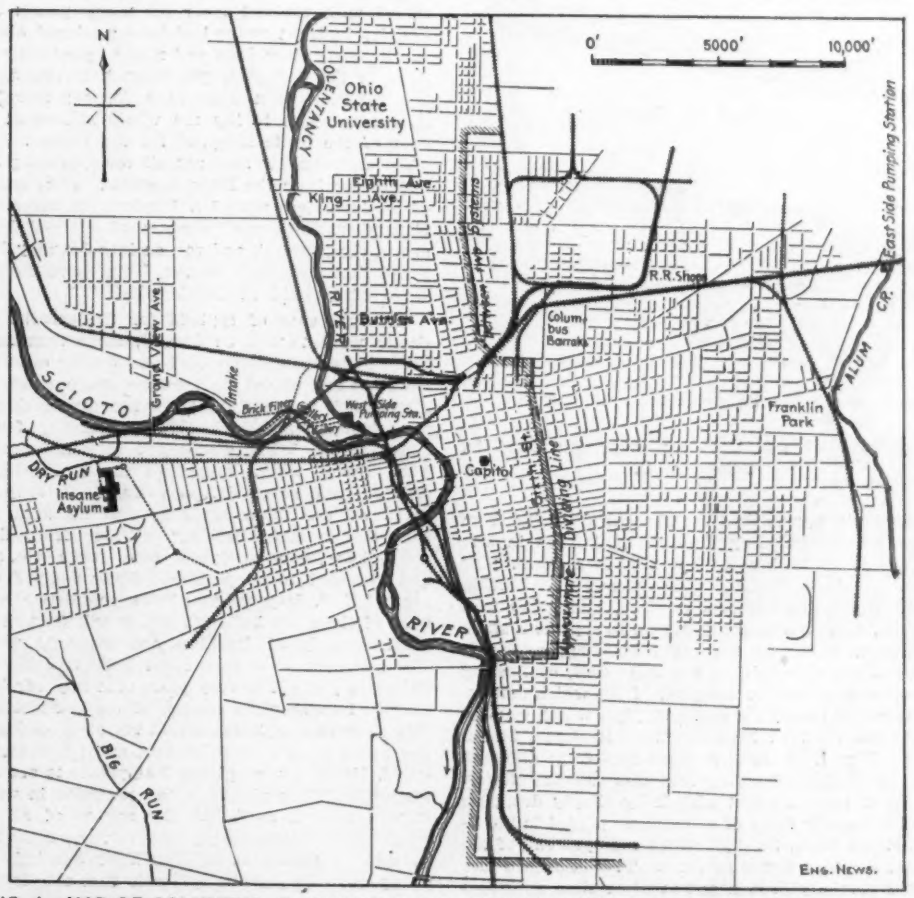


FIG. 1. MAP OF COLUMBUS, O., SHOWING LOCATION OF WATER-WORKS PUMPING STATIONS, APPROXIMATE AREA SUPPLIED BY EACH, AND LOCATION OF STATE HOSPITAL FOR THE INSANE.

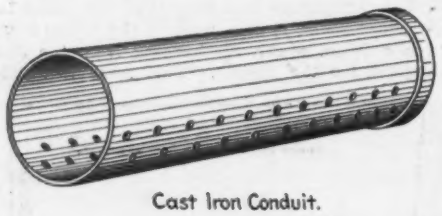
THE PRESENT TYPHOID EPIDEMIC AND ITS CAUSES.

There has been a notable amount of typhoid fever in Columbus for several years, probably averaging four hundred cases or more per year. On Jan. 12 the marked increase in reported cases began. From Jan 5 to 12, however, the health officers had been sending out warning notices to boil the water. Indeed, in December, one or more warnings were given. As soon as the rapid increase in cases reported indicated some unusual pollution of the water supply the city authorities began a systemadic search for the trouble. Bacterial and chemical anaylses were made of water taken from the city taps. Samples taken from various points along the Scioto River were also examined. On Jan. 14 sewage was discovered emptying into Dry Run, about ¼ mile west of the Scioto River, from a 20-in. sewer, discharging from the State Hospital for the Insane. This state institution is located upon the edge of the highlands skirting the southwestern edge of the Scioto valley and within the western portion of the city limits.

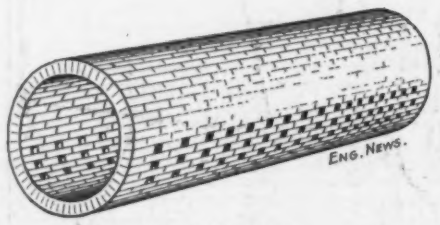
Dry Run is a creek flowing a small stream of water during the greater portion of the year and emptying into the Scioto River about 1¾ miles above the West Side pumping station (Fig. 1). Samples from the sewer emptying into Dry Run and from the Scioto River above and below the mouth of Dry Run were taken on Jan. 15 and analyzed. The sample from the Dry Run sewer was nearly as strongly polluted as average Columbus sewage. The sample from the Scioto, above Dry Run, showed considerable pollution, while that taken in the river below the mouth of Dry Run did not show as much pollution as the discharge of Dry Run would indicate, yet it was considerably more polluted than the river sample taken above the discharge. Mr. E. G. Horton, Bacteriologist and Chemist to the State Board of Health, states that

one reason why the sample taken below the mouth of Dry Run showed no greater pollution was undoubtedly the fact that the sample was taken in a portion of the river partially shielded from the creek discharge by an intervening island. The State Bacteriologist's report is given, in part, as Appendix III. While he does not lay all the pollution found in the river to the sewage of the State Hospital, he does say that he hopes now that further discharges from that institution have been prevented there will be a notable decrease in the epidemic as soon as the incubation period of the disease has passed for those last affected by the pollution, that period ending about Feb. 5.

A peculiar condition of sewers prevails at the State Hospital. A sketch, Fig 3, furnished by Mr. Julian Griggs, M. Am. Soc. C. E., City Engineer, shows the general plan of the buildings and sewers in relation to Dry Run. From a point in the rear of the main building a 3-ft. brick storm drain leads north under the building toward Dry Run. As



Cast Iron Conduit.



Brick Conduit.

Fig. 2. Brick and Cast-Iron Infiltration Conduits, Columbus, O.

this drain approaches the sharper declivity from the hill toward Dry Run, it diminishes in size from 36 to 24 ins., and finally to a 20-in. pipe sewer, which discharges into the creek. Within this storm drain is laid an 8-in., increasing to a 10-in., cast-iron sanitary sewer, to a point a short distance north of the main building, where it leaves the storm drain and runs east, connecting with a large well or cesspool, from which sewage is pumped through a cast-iron pipe, which empties into the river at Mound St., as is shown in the map, Fig. 1. Several laterals lead from different portions of the building into this sanitary sewer. Two of them connect with it by simply dropping the sewage in front of a bulkhead placed in the 3-ft. storm drain, through which the open end of the 8-in. sanitary sewer projects. This bulkhead had been partially broken out at some time unknown to the superintendent of the institution, allowing the sewage to flow directly into the storm drain and discharge into the creek.*

Tees had been inserted at various points along the sanitary sewer pipe within the storm drain, for some purpose not clearly understood by any of the present officials. One or two of these were found to be open, and evidences of overflow through them were found. Steps were immediately taken to repair the defective conditions, and in order to more thoroughly safeguard the city the State Hospital authorities were asked to put in an additional bulkhead at the point marked G on the sketch, Fig. 3, thus completely cutting off the discharge of storm water, as well as sewage, from emptying into Dry Run. This was done on Jan. 16 and diverted the storm drainage into the small sanitary sewer, and seriously threatened the institution with back water. The superintendent of the State Hospital, Dr. George Stockton, has been unjustly criticised because he asked permission from the City Board of Health to tear out this new bulkhead, as soon as he could clean out the fecal matter deposited in the storm sewer,* in order to give him the much needed outlet for the drainage of the storm water from the roofs of the buildings and surrounding yards. Within a few days after the bulkhead was constructed rain and thawing weather came and threatened to back water over his furnace fires, which would have cut him out of heat and light. Only the timely arrival of a fire engine to pump down the flood saved him from very distressing conditions.

In an interview with the State Bacteriologist, Mr. E. G. Horton, he said in substance that we must bear in mind that Columbus has been afflicted with typhoid fever for many years; that the city hydrant water had been analyzed almost continuously since 1899 and showed great fluctuations in the pollution, generally, however, showing pollution to a dangerous degree; therefore, it was not just to lay the whole offense at the door of the State Hospital for the Insane.

To further show that not all the typhoid pollution comes from the State Hospital, the substance of an interview with Dr. Stockton is given. In November, 1902, twelve cases of typhoid broke out in the hospital, and ran on into January, 1903. From that time until Jan. 3, 1904, there were no cases of typhoid at the hospital.

The first case of typhoid for the present epidemic went to bed on Jan. 3; since then seven cases have come down and two deaths occurred. All fecal and urinal matter from the patients are disinfected and sterilized by the application of formaldehyde and bichloride of mercury for 24 hours before being discharged into the sewers. The present water supply of the institution is secured from seven driven wells, 30 ft. deep, located on the farm lands several hundred feet east of the main building. Water from these wells has been analyzed from time to time and reported to be potable. Four wells drilled about 325 ft. deep are just being completed to the west of the main building, which will furnish the future supply of drinking and domestic water. The institution has at present 1,425 inmates and 200 employes. It is very plain that any carelessness in handling the sewage of an institution of this character and size would seriously endanger the water supply of Columbus, as at present secured. Naturally, suspicion first points to such an institution when placed in the condition in which it was placed, as being the source of all the troubles. It seems to be, however, the consensus of opinion among those who have carefully investigated this present epidemic that this is only one of the causes which has contributed to the typhoid epidemic in the city.

Above Columbus, along the Scioto River, are a number of places that can and do pollute the waters of the river. About three miles above the intake is situated the village of Arlington, which already has some sewage discharge that can reach the river. About five miles above the water-works are several large stone quarries in which the workmen are quartered in small houses immediately along the river, discharging all offal and wastes onto the rocky surfaces and into the ravines immediately along the river banks. From ten to twelve miles above the water-works station is situated the small village of Dublin, which, while it has no sewer system, is located upon territory having solid rock very close to the surface and which would carry away disease germs rapidly during a heavy rainstorm. Physicians residing in Dublin state that there has been no typhoid fever in that village for nearly three years.

About eighteen miles above the water-works station is situated the Girls' Industrial Home, in Delaware county, which discharges the entire sewage of some 800 people directly into the Scioto River.

Dr. McKendree Smith, Superintendent of the City Board of Health, has made an extended examination of the various points of possible pollution of the Scioto River above Columbus as far as Kenton, some 70 miles by the windings of the river. He found that there had been 25 or 30 cases of typhoid in Kenton during November and December last, and that from 12 to 15 of those cases had closets in the houses which discharged into sewers reaching the Scioto River.

Since that time and until the middle of January the river has been quite continuously frozen over, furnishing suitable conditions for carrying polluted water long distances without much opportunity for purification.

Dr. Smith says, that while it is possible, he believes, for typhoid germs to be carried that far and still retain their activity, he does not think it very probable.

A large percentage of the population of Marion, a city of 12,000 or 15,000, drains into the Little Scioto, a branch of the Scioto River. Marion is

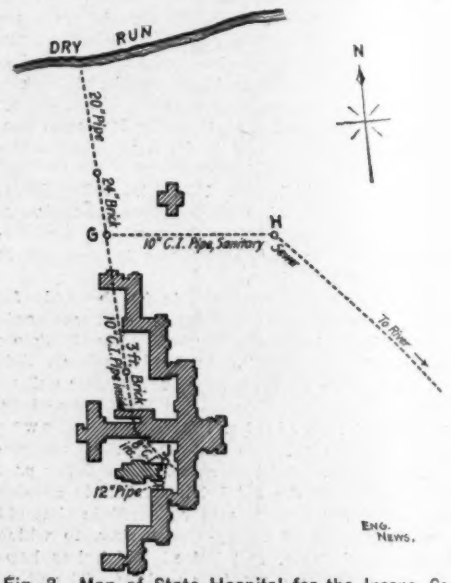


Fig. 3. Map of State Hospital for the Insane, Columbus, O., and Its Outlet Sewers.

(On this map the point marked G is where the new bulkhead was built into the storm sewer. The point marked J is the point where the old bulkhead was broken through allowing the sewage to flow into the storm drain. The point marked H is the cesspool from which the sewage is pumped into the Scioto River at a point below the heart of the city.)

about 45 or 50 miles above Columbus. Larue, Hepburn, Prospect and several other small villages drain more or less directly into the Scioto River.

The following tabulation of cases reported for the month of December, and daily since that time, shows the rapid and persistent increase in the epidemic up to Feb. 1 and its apparent decline since then:

							Cases.
December							40
Jan. 1....	1	Jan. 13....	26	Jan. 23....	41		
Jan. 4....	1	Jan. 14....	34	Jan. 24*...	16		
Jan. 5....	8	Jan. 15....	43	Jan. 25....	43		
Jan. 6....	3	Jan. 16....	47	Jan. 26....	25		
Jan. 7....	3	Jan. 17*...	2	Jan. 27....	48		
Jan. 8....	7	Jan. 18....	24	Jan. 28....	35		
Jan. 9....	4	Jan. 19....	48	Jan. 29....	47		
Jan. 10*...	1	Jan. 20....	24	Jan. 30....	81		
Jan. 11....	5	Jan. 21....	44	Jan. 31*...	19		
Jan. 12....	9	Jan. 22....	35	Tot'l Jan.			724
Feb. 1.....	130	Feb. 4.....	28	Feb. 7*....	16		
Feb. 2.....	48	Feb. 5.....	24				
Feb. 3.....	29	Feb. 6.....	44	Tot'l 7 days			319
Grand total to date							1,083

*Sunday.

Twenty-five deaths occurred up to Jan. 30 and 32 more up to Feb. 7, making 57 deaths thus far. While many of the cases are of a mild form there seems to be quite a large percentage of them that are of a malignant type. Geographically grouped, there are few cases in the district supplied by the East Side pumping station, and Dr. Platter thinks these few cases could probably be traced to those who do business in

*From a copy of an official report by Mr. Griggs, forwarded to us by Professor Eno, it appears that a screen placed in this cesspool or chamber was liable to become clogged, provided it was not regularly cleaned, in which case the sanitary sewage would be backed up and overflow into the storm sewer, and thus pass to the river. It was at first supposed that the sewage discharge, found by a gaging made on Jan. 14 to be at the rate of 116,000 gallons a day, came from such an overflow, but subsequently it appeared that it was due to the broken bulkhead mentioned herein. According to a report addressed to Mr. Robert H. Jeffrey, Mayor of Columbus, by Mr. H. O. Pond, Vice-President of the Board of Public Service, the investigation which resulted in this discovery was prompted by a description of the sewerage system at the State Insane Hospital, published in a report of the Ohio State Board of Health. This report showed that under certain conditions the sewage from the institution could reach the Scioto River above the Columbus water-works intake.—Ed.

*On Feb. 6, Dr. McKendree Smith reported that 22½ tons of fecal matter, rags, stones, sand, etc., had been removed from the storm sewer since attention was directed to its condition.

the heart of the city and use the hydrant water there. Of the remaining portions of the city there are not a great many cases located upon the west side of the Scioto River, which is attributed to the fact that a great many use well water in that section. Around the Ohio State University there are fewer cases, due to the fact that a large number of the residents within five or six blocks procure all their drinking water from a fine spring, located upon the university campus. The greatest density in typhoid cases occurs between 8th and Buttles avenues and between Olentangy River and Sixth St., a district which includes the most densely populated section in the northern portion of the city. The next densest group of cases is in the heart of the city. In the Ohio State Penitentiary, which is located on the north bank of the Scioto River, a short distance east of the West Side pumping station, there are about 30 cases among some 1,750 or 1,800 prisoners.

In the forty public schools, having an enrollment of between 19,000 and 20,000 pupils, there are about 175 cases. The School Board promptly shut off the city water supply to all the school buildings and arranged to furnish distilled water in barrels for drinking purposes.

It has been quite common during the last ten days to hear expressed in public the opinion that the typhoid epidemic is greatly exaggerated and that physicians are too hasty in reporting cases as typhoid where the slightest symptoms point that way.

One evening paper, and, of course, numbers of its readers, have expressed themselves as believing that it is only a political scheme for the present city administration to magnify the reports in order to increase public sentiment in favor of the various large public improvements of water supply and sanitation which those in power wish to have the honor of building.

These expressions are not worthy of consideration, except as proof of how far bitter partisanship will lead people to befog their own vision and judgment; and to account for the fact that no matter how much publicity is given to the necessity of boiling the water or of guarding against the use of a polluted water supply 'here are many people who will say, "this is the old cry of 'wolf, wolf,'" and will blindly continue to put themselves in danger's way by using raw water.

That there is an opportunity for misleading diagnosis, there is no doubt. Physicians report many cases of what they are terming "intestinal grippe." Dr. Platter of the City Board of Health says that it has many symptoms similar to typhoid, but lacks the high fever, and is of much shorter duration. Those who have friends sick are not questioning the diagnosis of typhoid fever.

That the water supply of Columbus is not a safe potable beverage at any time is proved by the typhoid mortality for Columbus for the past five years, or from 1899 to 1903, inclusive, which has been 39, 59, 47, 48, 46, with 25 deaths already reported for 1904. Accepting the usual death rate percentage for typhoid cases as 10% this would indicate that Columbus has been having an average of about 480 typhoid cases per year, with a population now estimated at 140,000 to 150,000.

Tests made on Jan. 16 of the East Side and West Side water supplies, taken from taps in the districts definitely influenced by each supply, showed the East Side supply to be a safe drinking water at that time, but showed serious pollution in the West Side water.

In an article in the Columbus Medical Journal of July, 1902, by Mr. E. G. Horton, State Bacteriologist, entitled "The Columbus Water Supply," two or three brief but suggestive tables are given. The following table shows the fluctuation in the various chemical analyses made by Mr. Horton, and the average of all such analyses made during three years:

Chemical Analyses of Columbus Water.
(Parts per 1,000,000.)

	Minimum.	Maximum.	Average.
Oxygen required	2.02	8.96	4.10
N as albuminoid ammonia	.074	.300	.165
N " free ammonia	.006	.042	.027
N " nitrites	Trace.	.070	.007
N " nitrates	Trace.	6.40	1.71
Chlorine	5.4	15.1	9.4
Alkalinity	161.0	267.0	212.0
Incrusting constituents.	73.0	232.0	152.0
Total solids	473.0	905.0	662.0

Mr. Horton says these results indicate "how undesirable and unsafe our present supply is."

Bacteria Per Cubic Centimeter in Columbus Water.

Year.	No. of examinations.	Minimum.	Maximum.	Daily average.
1899	174	120	20,000	2,841
1900	205	275	11,400	2,126
1901	83	110	16,000	1,300
1902	53	100	7,500	2,054
Total	515			2,228

Of this table Mr. Horton says:

A water that has an average of 2,200 bacteria to the cubic centimeter and that varies from 110 to 20,000 may truly be said to be open to pollution. A good soil water contains but few bacteria; e. g., some springs and drilled or driven wells contain anywhere from 0 to 100 to 200 bacteria per cu. cm.

He finds that only in 7% out of the 515 analyses do the bacteria fall below 300 per cu. cm. in the Columbus water.

This investigation shows that about 1,050 cases of typhoid fever have been reported in Columbus since Jan. 1. The prediction by the local health authorities that the crest of the epidemic would be reached by Feb. 5 seemed to have been correct, at least so far as the original outbreak is concerned, until the cases again rose on Feb. 6. It is to be noted that the sewage from the State Hospital for the Insane has been shut out from Dry Run, and thus from the West Side water supply, since Jan. 16, while about the same date or a few days later the Scioto River intake at the West Side station was shut off. While this intake was closed the water supply of the city was taken from the West Side filter galleries and from the East Side station, the normal supply at this station being supplemented by water taken directly from Alum Creek. On Friday morning, Feb. 5, Mr. Jerry O'Shaughnessy, Superintendent of Water-Works, reported to the board of health that he had been compelled to open the Scioto River intake again. It remains to be seen what effect this renewal of raw water in our West Side supply will have upon the typhoid situation.

Early last week Mr. Robert H. Jeffery, Mayor of Columbus, appointed a commission of physicians and prominent business men to thoroughly investigate and report upon the cause of the typhoid epidemic and aid in the efforts to check the progress of the disease. Mr. W. O. Thompson, President of the Ohio State University, was elected chairman of this commission. Sub-committees have been appointed as follows: (1) To look into conditions along the Scioto River. (2) To suggest means of immediate relief. (3) To inquire into the distribution of cases. (4) To urge the general assembly to take steps toward securing sanitary disposal of sewage at all state institutions and to secure improvement in sanitary conditions generally.

The following resolution was adopted by the commission:

That the attention of the public be called to the dangers from the use of raw hydrant water for cleaning purposes in households, restaurants, saloons and other places where receptacles for food and drink are cleansed, and that further attention be called to the danger from the use of such water for the cleansing of vegetables in households, groceries and markets.

(Certain reports of city officials forwarded to us by Professor Eno are reprinted, in part, below. References to them have been made in Professor Eno's article.—Ed.)

APPENDIX I.—DUTIES OF RIVER PATROLMEN

Extracts from Report of Jerry O'Shaughnessy, Superintendent of the Columbus Water-Works, to the Board of Public Service, January, 1904.

These patrolmen are four in number, two serving eight hours in day time and two serving eight hours at night. The two day men report at the West Side pumping station, in a book kept for that purpose, the time at which they come on duty and the time they are relieved. One of these men is used on the Olentangy River. We take no water whatever from this river, but complaints from residents of the city living on the east bank of this river became so frequent, on account of dumping of manure and the off-falls of hotels, groceries, restaurants, etc., on the river road, the stench from which was most obnoxious, especially in warm weather, that it was thought advisable to place a man there, since a great number of people believe that we are using water from this stream. This man patrols the river from the pumping station to King Ave. bridge. Twice a week he goes to Dodridge St. bridge. The King Ave. bridge is between 1½ and 2 miles from the pumping station; Dodridge St. about four miles.

The duties of the other day man are entirely confined to the Scioto River. He patrols this river between the West Side pumping station and Marble Cliff, and his duties take him to Grandview bridge every day. He has some duties to perform at the intake, which takes a couple of hours each day of his time.

The two night men are together on the Scioto River. They are not supposed to go beyond the Grandview bridge, as their main duties are to guard the river from any off-falls being dumped on or near its banks. I mean by off-falls the contents of soil-wagons and any or all garbage that may be carried out in that direction from the city. There being no probability of this sort of stuff being carried beyond the Grandview bridge, that being the last crossing of the river, it is unnecessary for these men to go further after night.

. . . . . .

In regard to the pollution of the Scioto River from the sanitary sewer of the State hospital, I want to say that I myself never had any knowledge that it was so constructed that it could, by any means, accident or otherwise, pass through Dry Run; as my idea always was that the sanitary sewage of both the State Hospital for the Insane and the Imbecile asylum was pumped by the Imbecile Hospital people through the sanitary sewer and emptied into the river at the Mound Street bridge.

Therefore, those river patrolmen had no instructions, that I know of, to particularly watch Dry Run, any more than several other ravines of the same nature that emptied into the Scioto River above our intake.

. . . . . .

I made a personal investigation of Dry Run directly after the matter had become public, and I found, where Dry Run empties into the river, that everything was frozen solid and there was from 3 to 5 ins. of snow over the ice. The men might pass along there and never be able to detect anything out of the ordinary. Following Dry Run from its mouth I went up and through the run south of the Little Miami railroad, a distance of about 3,000 ft., and there I met with a picket fence protected by barbed wire on top surrounding the asylum grounds. Our patrolmen, in order to investigate the source of pollution in Dry Run, if any was discovered, would have to enter the asylum grounds and would have to do so at the Broad St. entrance.

There have been several questions asked in regard to the duties of river patrolmen and whether or not they follow each tributary of the Scioto River to its head. This has not been the practice, the main reason for which has been that we have had no authority to abate nuisances on private property beyond the city limits.

There is no one who can possibly be more concerned as to purity of the water than those in charge of the water department, and we have done everything in our power to prevent the pollution of the stream.

If it is deemed necessary to patrol a larger scope of territory, including the small streams to their sources, a much larger force of patrolmen will be required.

APPENDIX II.—LEGAL CONTROL OF POLLUTION OF THE WATER SUPPLY OF COLUMBUS.

Extract from Report of David T. Keating, Second Assistant City Solicitor, to Robert H. Jeffrey, Mayor, of Columbus, Jan. 16, 1904.

Since the adoption of our new municipal code, it is doubtful whether our local Board of Health has any specific jurisdiction outside of the corporate limits of the city. We therefore ask that your Board of Health report each case of pollution of the water supply of our city to the Law Department. Any such nuisance can promptly and effectively be stamped out by this strong arm of the law through the remedy of injunction, and our department stands ready to apply to the courts for an injunction in all cases where your Board of Health deems such application advisable.

APPENDIX III.—ANALYSES OF WATER FROM SCIOTO RIVER, FROM DRY RUN SEWER AND FROM LABORATORY TAP.

From Report dated Jan. 15, 1904, by E. G. Horton, Bacteriologist and Chemist of the Ohio State Board of Health. Dr. C. O. Probst, Secretary of the Board.

(Parts per 1,000,000.)

Source of sample.	Scioto R. 500 ft. above Dry Run.	Sewer entering Dry Run.	Scioto R. 900 ft. below Dry Run.	Tap in laboratory.
No. of sample	3,433	3,434	3,435	3,432
Color	43	40	30	30
Turbidity	10	90	12	10
Sediment	Trace.	Consid'bl.	Trace.	Trace.
Odor	Vegtble.	Sewage.	Veg.*	Vegtble.
Oxygen required	5.88	31.88	6.22	4.14
Nitrogen as:				
Am. albuminoid	.234	5.100	.306	.178
Ammonia free	.210	7.000	.258	.132
Nitrites	.014	.040	.026	.016
Nitrates	3.8	1.0	3.8	3.6
Chlorine	7.1	392.0	7.2	9.9
Alkalinity	288	312	288	293
Total solids†	567	1,243	589	622
Loss on ignition	55	289	...	176
Bacteria pr cu.cm.	2,350	590,000	1,800	1,100
Colon bacilli in 1 cu. cm	Yes.	Yes.	Yes.	Yes.

*Vegetable and faint musty.
†Incrusting constituents.

These samples were received on the 15th inst., having been collected by Dr. McKendree Smith, Health Officer of Columbus.

The results of sample No. 3,434 show the material entering into Dry Run from the 20-in. sewer was fresh sani-

tary sewage. A comparison of the results of this sample with our examination of samples of Columbus sewage, taken from the first manhole south of Moler St., on Dec. 29 and 30, last, show that the sewage from this 20-in. sewer, at the time of sample, was nearly as strong as the city sewage.

At the outset it should be remembered that it is often a difficult matter to obtain a sample, after the union of two streams, that will fairly represent a mixture of the two, for some times the waters do not mix as readily as might be thought. While the analyses show that the water below Dry Run is somewhat more polluted than that above Dry Run, the indications are that sample No. 3,435 was taken at such a point as to have contained only a small quantity of the water coming from Dry Run.

The results from sample No. 3,433 show that the water above Dry Run at the time of sampling, was sewage polluted, and to such an extent as to be a serious menace to the health of the community if that water is used as a partial source for the public water supply of the city.

The individual determination of the tap water sample would in some cases be increased, and in others decreased, on account of the character of the ground water which furnishes a portion of the West Side supply. However, the results from sample No. 3,432 show that the city water at the date of sampling was seriously polluted with sewage and not safe for use in the raw state.

SEWAGE PURIFICATION MADE COMPULSORY BY THE MINNESOTA STATE BOARD OF HEALTH.

By H. M. Bracken,* M. D.

In Minnesota the laws give to the State Board of Health general supervision over all water supplies. In 1902 the said board consulted its attorney relative to such supervision. His reply was as follows:

I am of the opinion that your board has full power and authority to supervise the sources of all water supplies of towns, villages and cities in this state, with reference to the purity of their water, and full power to examine the conditions of the water supplies, and, in case of the pollution of any thereof, to stop the use of such water whenever the public health requires it.

In my judgment, examinations with respect to the purity of water supplies should be made from time to time by your board, upon resolution.

In case at any time you find that pollution of a water supply exists, a time and place may be appointed by your board for hearing the parties to be affected. Notice of such hearing should be given to all parties interested, and if upon the hearing your board determines, in its judgment, that the public health requires it, you may order the difficulty remedied.

In case your orders are not obeyed, you are authorized to apply to the District Court and have your orders enforced.

As a result of the above opinion, the board at its meeting, July 9, 1902, passed the following resolutions:

Resolved, That from this date all villages, cities and public institutions contemplating putting in new water plants, or repairing or extending old systems, shall submit to the State Board of Health a statement showing the source from which the water is to be taken, and the plans, if any, for purification or filtration of the water.

Resolved, That from this date all villages, cities and public institutions contemplating putting in new sewerage systems, or repairing or extending old systems, shall submit to the State Board of Health a statement showing the source and place of discharge for all sewage from such systems, and the plans, if any, for the purification or filtration of the sewage.

Under date of July 16, 1902, a circular letter was prepared giving the legal opinion and the resolution already quoted, and ending up with the following:

I trust you will appreciate the position of the State Board of Health in its effort to aid the various villages and cities throughout the state in securing and maintaining pure water supplies. It is the wish of the State Board to prevent the construction of unsanitary water plants or sewerage systems, and the consequent waste of money.

I am sorry to say that little attention was paid to this circular letter. Because of this fact, the matter was taken up with our attorney-general and he advised the board to draw up some pretty positive resolutions, together with a penalty for their disregard. As a result, the board at its regular meeting, Jan. 12, 1904, took action as follows:

Whereas, The laws of the state provide for the protection of any cistern, well, pond, lake, stream or river in Minnesota against pollution from sewage, drainage or refuse, and

Whereas, With the growth of the state and the construction of sewers for villages and cities, there is a constant tendency towards the pollution of such sources of water supply, now, therefore,

Be It Resolved, That the discharge of sewage by any village, city or other municipality, by means of artificial drains, or a sewerage system, into any well, pond, lake, stream or river in Minnesota, is declared to be a public nuisance and hereby prohibited, unless such sewage is first passed through a septic tank, or filter bed, or both, as the case may require, the plans for the construction of said septic tank or filter bed having been first approved by the Minnesota State Board of Health;

Provided, That this resolution shall not apply to any such discharge of sewage from any drain or sewerage system heretofore constructed, until after Jan. 1, 1905.

Any person, village or city, or village or city officer, violating or assisting in the violation of the provisions of this resolution, shall be deemed guilty of a misdemeanor and punished by a fine of not less than $50 nor more than $100 for every day such sewage is permitted to run into any such well, pond, lake, stream or river.

I trust the spirit of the action of the board will be appreciated. Its intent was to prevent further pollution of streams. It is very important that some such action should be taken, for as our state becomes more densely populated our water supply would become so polluted as to cause much trouble. The board had no intention of being arbitrary or exacting in this matter. It simply stated that sewage must be partially or completely purified, as the case may require. The board is ready to give expert engineering advice without expense to a municipality. This does not mean that the board has any intention of interfering with sanitary engineers in their professional duties, but rather that the sanitary engineers shall have the advantage of our support in the proper construction of sewerage systems.

The proviso seemed to frighten a good many cities and villages, and the newspaper clippings from these various municipalities indicated at once the number of places that were now disposing of sewage contrary to the laws of the state. Many of these places interpreted the proviso as to become mandatory after Jan. 1, 1905. This was not the intention of the board. It felt, however, that it should assert its position and establish a standpoint from which to work in the future. The board will use its discretion in taking action against sewerage systems already in existence.

*Secretary Minnesota State Board of Health, St. Paul, Minn. This statement of the advanced position taken by the board named was prepared at our request. Comments on the action of the board will be found in our editorial columns.

A BOTTOM-DUMPING CONCRETE BUCKET.

The accompanying illustrations show a new style of bucket for handling concrete. This bucket discharges its load at the bottom as does the ordinary steam shovel dipper and by this means avoids the shock of discharge and annoying rebound characteristic of top dumping buckets. A glance at the illustrations is sufficient to explain the construction and operation. It will be noted that the inside of the bucket is distinctly dipper-shaped, with rounded corners and smooth sides. The bottom is very much like that of a steam shovel dipper in both construction and operation; it is latched and unlatched automatically. This bucket has been used on a number of large concrete structures with success. It is built by Jones & Harold, of Jersey City, N. J.

Exterior View.

Interior View.

A BOTTOM-DUMPING CONCRETE BUCKET.

NEW SHOPS OF THE CHICAGO, ROCK ISLAND & PACIFIC RY. AT EAST MOLINE, ILL.

During the past year or two, a rather notable feature of railway work has been the extensive improvement of railway shop plants, either by revising and enlarging existing plants or by the construction of entirely new plants. An example of the revision of existing plants is afforded by the Topeka shops of the Atchison, Topeka & Santa Fe Ry., described in our issue of April 2, 1903, and in the present article we describe the new plant of the Chicago, Rock Island & Pacific Ry., at East Moline, Ill.

At this point the railway company has acquired a large tract of land as a site for locomotive, freight car and passenger car shops, general storeyard, repair tracks, etc., and also for a division roundhouse and division freight yards. A general plan of the shops and yards is shown in Fig. 1. The main building, which is 276 ft. 8 ins. × 860 ft. 2 ins., comprises the locomotive erecting, machine and boiler shops, and is said to be the largest railway shop in the country. It is notable not only for its size, but also for the peculiar arrangement of the erecting pits, as noted further on.

The place selected for the location of the shops is 174 miles west of Chicago, near the cities of Moline, Rock Island and Davenport. Crossing the Mississippi River at Rock Island and Davenport, the Rock Island Ry. System diverges in three directions; to the northwest to reach St. Paul and Minneapolis; to the west to Omaha and Denver, and southwest to Kansas City and beyond. The site is five miles east of Moline, in a depression between the valleys of the Mississippi and Rock rivers, and distant about two miles from each stream. The elevation is 592 ft. above sea level and 38 ft. above low water in the Mississippi River, which rises here about 15 ft. Early in 1903 the company purchased a tract of 800 acres, 1½ miles long and about one mile wide. Upon this were 32 farm houses and dwellings, numerous barns and out-buildings, orchards, vineyards, etc. The soil is sandy and very favorable for the construction of the plant. Not all the tract was necessary for its erection, but was purchased as no owner wanted to part with a portion of his holdings. A strip 1½ miles long and ¼ mile wide was graded for the freight yard, shop plant and yard. From this tract 500,000 cu. yds. of earth were removed.

The general supervision of these works is, ac-

cording to the railway company's organization, vested in the Chief Engineer, at that time Mr. J. F. Stevens (now Fourth Vice-President) and later Mr. W. L. Darling. Mr. J. N. Brown was appointed Engineer in Charge for the railway company, and maintained an office, engineering and inspection force on the ground.

On Jan. 15, 1903, a committee was appointed consisting of Mr. Geo. F. Wilson, at that time Superintendent of Motive Power; Mr. G. F. Forbes, Assistant Purchasing Agent, and Mr. C. A. Seley, Mechanical Engineer. Shortly after appointment Mr. Wilson was succeeded by Mr. M. K. Barnum, the present Superintendent of Motive Power. This committee was authorized to submit plans and recommendations covering the general questions of power, lighting, heating and tool equipment for shops capable of repairing 60 engines per month. They were also to consider car department repair shops in regard to general dimensions and location, although no provision has been made at present for their erection. In this connection, however, the importance of providing suitable arrangement and location for the power house, blacksmith shop, and store, which are common to both the locomotive and car departments, was fully realized. A preliminary plan with a letter covering the general questions at issue was prepared by the committee and submitted to the management in about three weeks. It was approved without delay, and the committee was continued to assist in making detail plans, specifications and contracts for the equipment and its arrangement. In this work the committee was assisted by Mr. C. H. Wilmerding, Consulting Engineer, of Chicago, who also undertook the inspection of the erection of the power house machinery and equipment, and all piping and wiring.

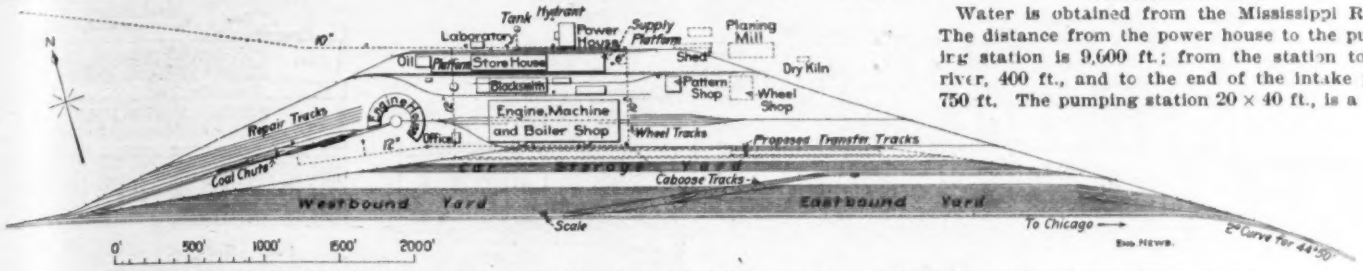


FIG. 1. GENERAL PLAN OF NEW SHOPS AND YARDS AT EAST MOLINE, ILL.; CHICAGO, ROCK ISLAND & PACIFIC RY.

M. K. Barnum, Superintendent of Motive Power; C. A. Seley, Mechanical Engineer; Geo. B. Swift & Co., Chicago, Contractors for Buildings.

FREIGHT YARD.

The freight yard, shown in Fig. 1, lies next to the main track and is 1½ miles long, 500 ft. wide, with ladder tracks at each end and through the middle. There is room for 35 tracks in width, but for the present the yard will contain 25.5 miles of tracks with a capacity of 3,000 cars. The grade is level, except for 1,000 ft. at the east end which has an inclination of 0.4%. The ground rises from the main track until at 500 ft. distance it is 4 ft. higher. The switching leads and ladder tracks are of 80-lb. rail; the sidings have 60-lb. rails.

The westbound yard has 14 tracks; 13 of these are body tracks 3,360 ft. long between headblocks, with a capacity of 1,030 cars; the other is a drill track. These tracks are 13 ft. c. to c., and the drill track is 16 ft. from the main track. The eastbound yard has 15 tracks; 14 of these are body tracks 2,730 ft. to 4,000 ft. long, with a capacity for 1,200 cars; south of these is the drill track, and the track spacing is as above. Between these two yards are diagonal tracks 13 ft. c. to c., with two caboose tracks for each yard, and a drill track 3,600 ft. long, connecting with the car storage yard. This has six tracks 13 ft. c. to c., 3,900 to 4,730 ft. long, with a capacity for 612 cars. The east end of this yard has two additional tracks on the south; the first is an open or clear track and the outer one is a drill track.

SHOP YARD.

Outside the freight yard are the tracks devoted to the use of the shops and storehouses. In this yard are nine miles of track. Two tracks extend through the erecting shop for bringing in the engines and material, and one track runs through the blacksmith shop. The storehouse is served by two tracks on each side; and the power house has one track for coal delivery. At the east end are five tracks (600 to 980 ft. long) for storage of wheels and trucks, and at the west end are five car repair tracks, 20 ft. c. to c., and from 1,420 to 1,950 ft. in length.

WATER SUPPLY.

Water is obtained from the Mississippi River. The distance from the power house to the pumping station is 9,600 ft.; from the station to the river, 400 ft., and to the end of the intake pipe, 750 ft. The pumping station 20 × 40 ft., is a neat building of dark red brick, with slate roof. In it are installed two triplex pumps, each of 1,000,000 gallons capacity. One is directly connected to a 60-HP. gasoline engine, the other to a 50-HP. electric motor, receiving power from the power house.

The intake is 12 ins. diameter and the main to the plant 10 ins. diameter. There are two tanks, each of 100,000 gallons capacity, the high service tank being elevated 108 ft. for fire protection. From this runs a special line serving the exterior and interior of the buildings. The boilers are also connected to the high-service line for washing out and for using water from this tank during the winter. The low-service tank is elevated 20 ft., sufficient to distribute water over the plant, the intention being to reduce the cost of pumping to a minimum.

The pipe line completely surrounds the buildings, and the main leading from the low-service tank to the water cranes is 20 ins. diameter. In all there are 17,000 ft. of water pipe and 16 fire hydrants. The water-works plant was built by the Otto Gas Engine Works, of Chicago.

SEWERS.

All the buildings are drained into a system of

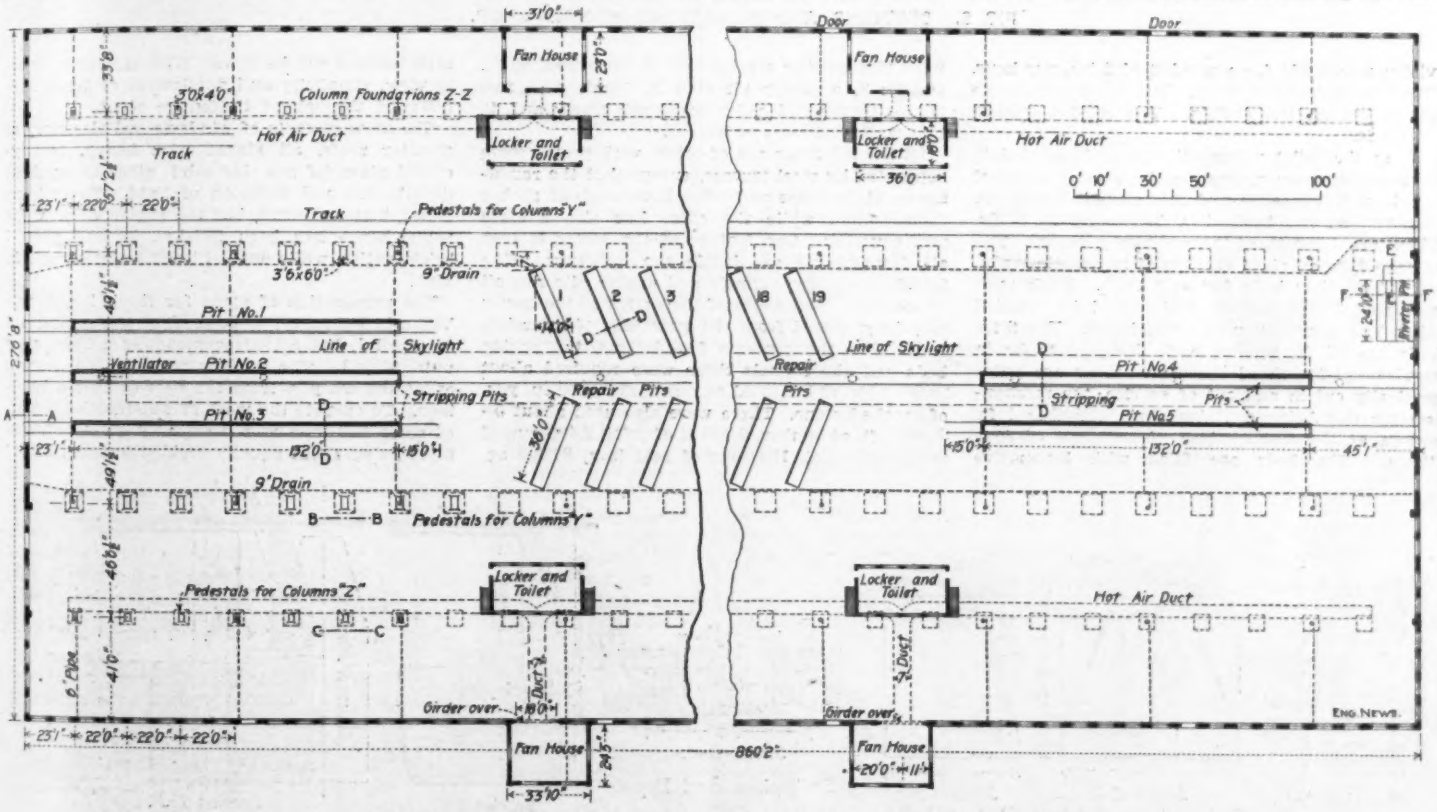


FIG. 2. PLAN OF LOCOMOTIVE ERECTING, MACHINE AND BOILER SHOP.

storm-water sewers, which also take care of the surface water in the immediate vicinity of the buildings. The difficulty of planning the sewers was increased on account of the tunnel which connects the various buildings with the power house. For this reason the sewer system was divided into two parts, one draining approximately half of the buildings to the east and north, and the other half to the west and north. Provision was made for a rainfall of 2 ins. per hour. The sewers begin at 8 ins. diameter and increase to 18 ins. at the outlets. The total length is 10,600 ft.

From the toilet rooms all sewage is carried in a separate sewer system to the sewage disposal plant, and the sewers of this system are 6 ins. diameter at the beginning, increasing to 8 ins. There are 4,700 ft. of these sanitary sewers. The sewage disposal plant consists of two septic tanks, with four filter beds for each tank. Each tank will hold 35,000 gallons, and should be emptied when in full operation every 24 hours. The filter beds are 24 ft. square, each designed to be in service one-fourth of the time. They are automatically cut in and out of service, the mechanism for this being contained in a chamber 4 ft. square at the intersections of each set of four filters. The beds are filled with locomotive front-end cinders 4 ft. deep, overlying a layer of 12 ins. of broken stone.

The other facilities, to be provided later and shown by dotted outlines on the plan, Fig. 1, will include the following: 1, coach repair shop and paint shop, with transfer table between them; 2, freight car repair shop, 160 × 517 ft.; 3, planing mill, 97x301 ft., with dry kiln and covered shed; 4, wheel shop, 150x150 ft.; 5, pattern shop, 100x100 ft.; 6, laboratory, 40x90 ft. In connection with the round-house there will also be, 7, a coal chute with two coaling tracks (205 ft. long and 50 ft. apart); 8, a cinder pit (160 ft. long), with two engine tracks and a depressed ash track; and, 9, two water columns or cranes.

All the buildings are of brick, with gravel roofs supported by steel trusses, except that the round-house, store-house and office have roofs of timber construction, while the office has also a slate roof covering. One feature of the design is that all down-spouts are inside the buildings. The foundations, pipe tunnels and engine pits are all of concrete. Some idea of the extent of the works may be gathered from the quantities of materials used. For the concrete foundations, the engine beds and the tunnels there were required about 22,000 bbls. of Portland cement and 20,000 cu. yds. of crushed stone. There were also used about 5,000,000 ft. of lumber, 6,000 M of brick, 2,400 tons of structural steel, 150 tons of cast iron, 64,000 sq. ft. of factory ribbed glass, 20,000 sq. ft. of wire-glass skylight, and 420,000 sq. ft. of composition roofing. In the construction of the main building alone 1,800 tons of structural steel was used, and it is of interest to note that this was on hand ready for erection within four months after the orders were placed. We are informed that, although this material was manufactured at three of the plants of the American Bridge Co., there was not a single misfit measurement or shop error, and this is said to be equally true of the other buildings.

The buildings were designed and constructed by the Geo. B. Swift Co., of Chicago, under the personal supervision of Mr. Geo. F. Jenkins, of that firm, who has had some years of practical experience in the construction and maintenance of railway buildings. It is believed that while these buildings are of the greatest efficiency desired and of permanent character, the cost of construction has been reduced to a minimum and the cost of maintenance will be light. With the latter object in view, simplicity and duplication of detail were followed throughout the entire plant.

The arrangements of windows and clerestory or monitor roofs, all glazed with heavy, factory-ribbed glass (of one size only), gives an excellent distribution and diffusion of light. There is no attempt at ornament, but the engine room of the power house has been finished in buff pressed brick, with a white enamel brick wainscoting 7 ft. high.

The preparation of plans for the buildings was begun in February, 1903; grading was commenced on April 1, but actual construction did not start until May 1. The grading required the removal of 200,000 cu. yds from the sites of all the buildings. To execute the work of construction a force of some 600 men was constantly employed, this force being about equally divided between skilled and unskilled labor. Quarters for the latter were provided on the grounds, where (as is the custom with foreign laborers) they boarded themselves. A boarding camp, however, operated by the National Hotel Co., was built and maintained on the grounds for the skilled and native employees. This was made necessary from the fact that the work was situated several miles from any place where suitable quarters could be secured. The grading and the construction of buildings, sewers and water supply systems were carried on simultaneously. The contractors and the local en-

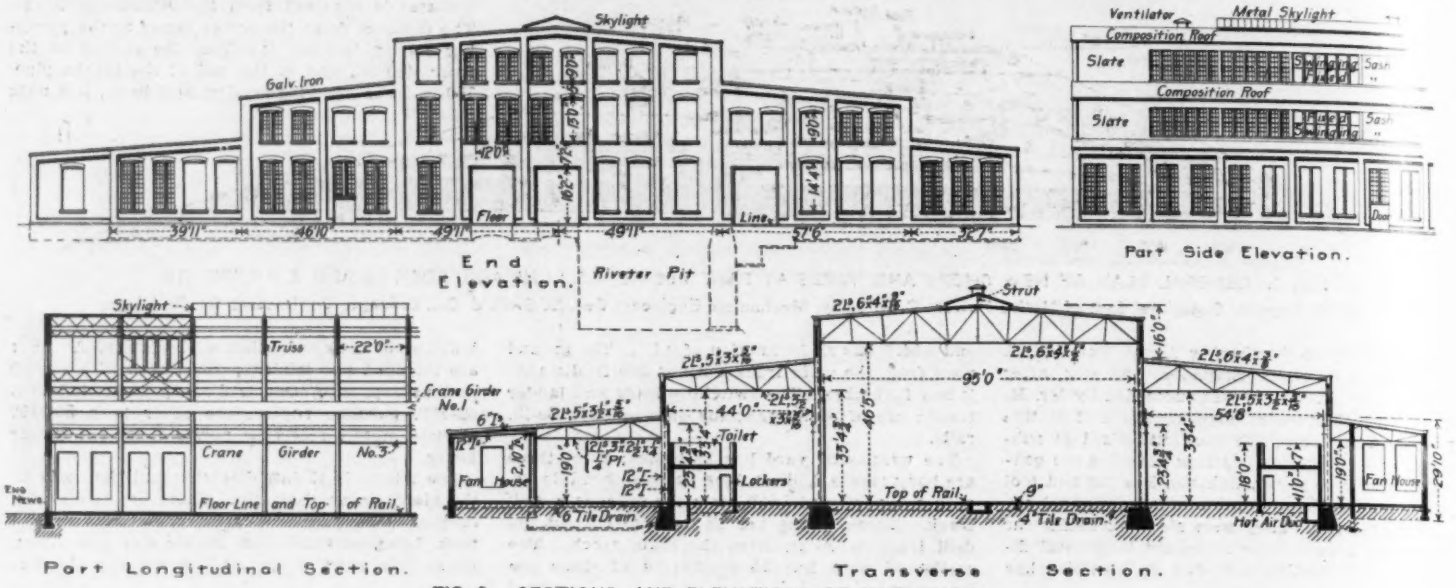


FIG. 3. SECTIONS AND ELEVATIONS OF MAIN SHOP.

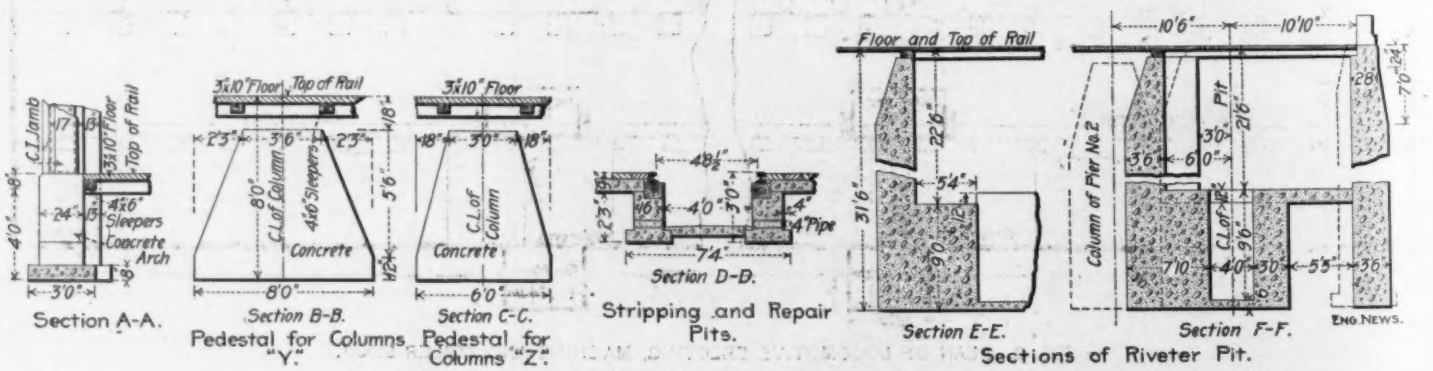


FIG. 4. FOUNDATIONS AND ENGINE PITS OF MAIN SHOP.

BUILDINGS.

The buildings erected in 1903 are eight in number:

1. Locomotive erecting, machine and boiler shops .....276 ft. 8 ins. × 860 ft. 2 ins.
2. Blacksmith shop (including brass foundry 85 × 99 ft) .....99 × 465 ft.
3. Store house (three stories) .....100 × 500 ft.
4. Power house .....154 ft. 6 ins. × 104 ft. 11 ins.
5. Refined oil house .....102 ft. 10 ins. × 62 ft. 8 ins.
6. Crude oil house .....35 × 21 ft.
7. Engine house.....30 stalls; width.....80 "
8. Master Mechanic's office (two stories) .....48 × 60 "

gineers (the latter under Mr. J. M. Brown, as already noted) have been complimented upon the record of progress made on this work. While the entire work was completed in a little more than six months, 31 days was entirely lost on account of rain.

ERECTING, MACHINE AND BOILER SHOP.—This building covers about 5½ acres and is divided into five bays, as shown in the plans and cross-section in Figs. 2 and 3. These bays are 39 ft. 7 ins., 46 ft. 6½ ins., 98 ft. 3 ins., 57 ft. 2½ ins. and 32 ft. 5 ins. A 3-in. wood floor covers the entire building, and the south bay has a 6-in. bed of concrete under the floor, as this bay contains the belted machines, driven in groups by electric motors. A few of these machines have special foundations. In the central bay are the stripping pits, the repair pits and the riveter pit. In the fourth bay are the hydraulic tools of the boiler shop, while in the fifth bay are the wood-working and boiler shop tools.

The building is heated by the Sturtevant hot-blast system, the air being forced by four fans (driven by electric motors) through concrete conduits underneath the floor, connecting with sheet-iron uptake pipes placed against the columns at various points. There are eight Shaw electric traveling cranes in the building: two 50-ton cranes in the central bay, one 10-ton and two 3½-ton cranes in the second bay, a 20-ton and a 10-ton crane in the fourth bay, and a 20-ton crane to serve the riveting pit.

The special and peculiar feature of this shop is in the arrangement of the engine repair pits, these pits being set diagonally to the center line of the building, as shown in Fig. 1. This gives ample room for removing and setting tubes, etc., without interfering with work on the opposite pits. The engines are run into the ends of the shop on the longitudinal tracks and stop over the longitudinal pits to be stripped, after which the two 50-ton cranes carry them to the repair pits. The details of these pits and of the column foundations are shown in Fig. 4.

BLACKSMITH SHOP.—This building, Fig. 5, is 50 ft. north of the machine shop, and 85 ft. of its west end is partitioned off and fitted up as a brass foundry. The steel roof trusses are 20 ft. c. to c., and rest on the brick walls. It is heated by means of a fan set on a platform 16 ft. 6 ins. above the floor.

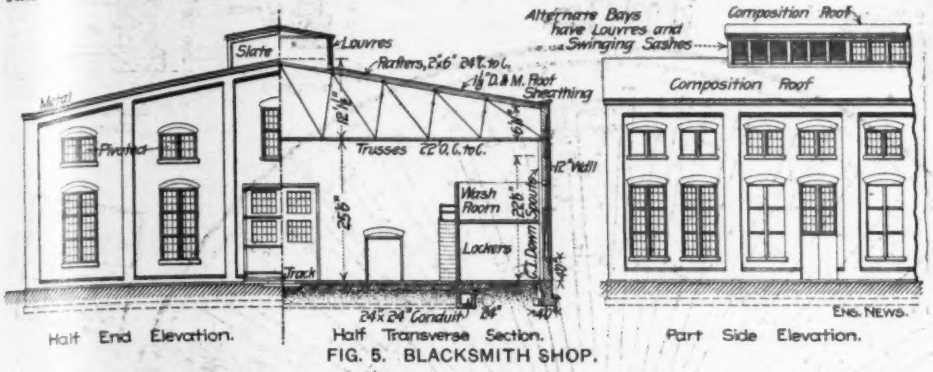


FIG. 5. BLACKSMITH SHOP.

STORE HOUSE.—This building has brick walls, with interior construction of wood, as shown by the sectional views in Fig. 6. The wooden posts of each story are fitted with cast-iron caps, which form seats for posts above and rests for the floor joists. One of the caps is shown in detail in Fig. 7. On the second floor are the offices of the general foreman, the storekeepers, etc. The building has two elevators of 2½ tons capacity, and is heated by means of two fans. A lantern or monitor roof extends over all but the end bays, and is fitted with swinging sash.

The first floor is 4 ft. above the rail, and has 3 ins. of timber on a bed of cinders. On each side is a 16-ft. platform, and beyond the east end extends a platform 132 × 400 ft. An 80-ft. traveling crane for handling heavy stores spans part of the width of the platform and the track next to it; the crane runs the full length of the platform and 60 ft. beyond it.

POWER HOUSE.—This lies about 60 ft. north and 95 ft. east of the store house, being centrally located to provide for future buildings. It has a basement 9 ft. 6 ins. deep. Fig. 8 is a plan, showing the arrangement of the machinery. The engine room and boiler room are each 49 ft. 10 ins. × 150 ft., and the former is served by a 10-ton traveling crane. On the south side is an extension 18 × 33 ft., through which runs the coal track. Below the track is a coal hopper and above it an ash hopper, so that a car which has delivered a load of coal can receive a load of ashes. A conveyor handles the coal and ashes. On the west side is a room for the induced draft plant, 41 × 25½ ft. There is a steel chimney 60 ft. high.

OIL HOUSES.—These are two in number, for the refined and crude oil respectively. The former is 260 ft. west of the store house, and has a basement 59 ft. square, in which are nine storage tanks: six of 12,000 gallons capacity and three of 6,170 gallons each. The floor of the building is 4 ft. above the rails, and the shipping room is over the oil room, the oil being forced up from the tanks by compressed air. Next to the shipping room is the barrel room, 20 × 60 ft., and next to this is the waste room, 60 × 28 ft. These rooms are entirely separate from each other, and are all heated by steam.

The crude oil house is 29 ft. south of the other, and its floor is 6 ft. 3 ins. below the ground. It contains two tanks of 2,330 gallons capacity, from which the oil is forced by compressed air through pipes to the points where it is needed.

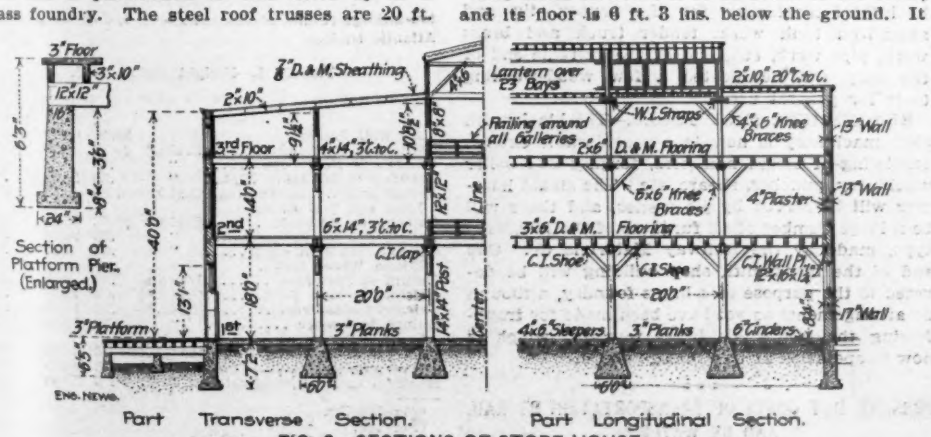


FIG. 6. SECTIONS OF STORE HOUSE.

ENGINE HOUSE.—The round-house is 377 ft. 8⅝ ins. diameter over the outside walls, and has 30 stalls, but when completed it will have 48 stalls. The general arrangement is shown by the plan, Fig. 8, while Fig. 9 shows the construction features. One track extends through the house, and all the tracks are served by a 75-ft. turntable, operated by an electric motor; the center of this table is 107 ft. from the house. The engine pits are 60 ft. long and 4 ft. wide, and two of them are connected by wheel pits, one for driving wheels and the other for truck wheels. A heating conduit extends around the inside of the rear wall, and from this tile pipe conduits are run to the pits.

Near the round-house is the cinder pit, 160 ft. long, a section of this being shown in Fig. 10. On each side of the depressed track for ash cars is an engine-cleaning track over a pit having the bottom and outer side faced with paving brick. The inner side is open to the ash car track. One rail rests on the concrete retaining wall and the other on a 15-in. I-beam, supported by cast-iron pedestals 10 ft. apart. These pedestals are incased in concrete. At each pedestal a 12-in. transverse I-beam ties the 15-in. beam to the retaining wall and maintains the gage of the track.

PIPE AND CABLE TUNNELS.

From the power house a tunnel 6½ ft. high and 6 ft. wide extends to the various buildings, diminishing in width to 5 ft. and 4 ft. where less capacity is required. The tunnels, Fig. 11, are of concrete, with a roof 6 ins. thick reinforced by expanded metal. On each side are brackets; those on one side supporting the electric cables and those on the other side supporting the steam pipes. The total length of tunnels is about 2,120 ft.

POWER HOUSE EQUIPMENT.

In the boiler room there are six Babcock & Wilcox water tube boilers of 33 HP., making a total present capacity of 1,800 HP., while there is room for other boilers to bring the ultimate capacity up to 3,000 HP. The coal is handled by a C. W. Hunt conveyor, which also takes care of the ashes. This conveyor has a capacity of 30 tons per hour, and the coal hoppers, located in the roof framing, are each of 36 tons capacity. The coal is discharged from these hoppers into Green chain-grate stokers, which are driven by steam engines located in the basement. The flue gases traverse a Green economizer and are handled by duplicate induced draft apparatus instead of a large chimney. The boiler feed pumps are of the Worthington vertical Admiral type, and in the boiler house are two March vacuum pumps for the heating system.

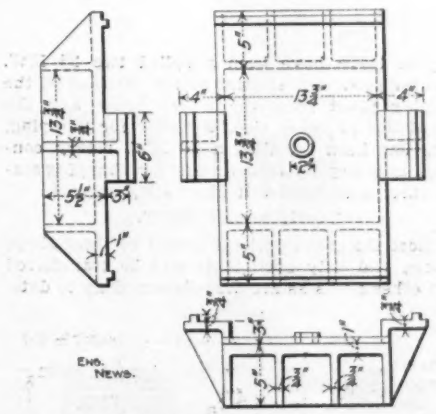


Fig. 7. Cast-iron Caps for Timber Posts of Store House.

In the engine room there are two General Electric direct-current units, 500 KW. and 250 KW., for 250-volt current. The engines have been furnished by the Buckeye Engine Co., and are of the cross-compound, non-condensing, direct-connected type. A 10-ton hand-power traveling crane is provided for use in erecting and repair work in the engine room.

Compressed air will be furnished by two Ingersoll-Sergeant compressors each of 1,500 cu. ft. capacity. Water at 1,500 lbs. pressure for operating the hydraulic tools in the boiler and blacksmith

shops will be supplied by two 100-gallon Worthington pumps, which deliver to an accumulator also located in the power house.

The electrical service for the shops will be on the direct-current three-wire system, and for this purpose there have been supplied two 25 KW. balancer sets. On account of the distance of the pumping plant from the power house and the desirability of using electric power for pumping, there has been installed a 50 KW. rotary converter and step-up transformer for changing station current to 2,200-volt alternating current.

TOOL EQUIPMENT.

Almost the entire tool equipment of these shops is new, and only such tools will be transferred from other shops as are first-class and up to date.

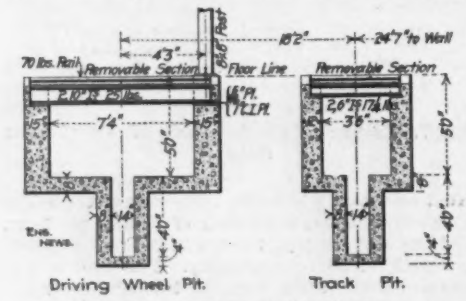


Fig. 8a. Sections of Wheel Pits.

The tools which have been purchased have in almost all cases been delivered and erected, and are 200 in number. All tools which do not require crane service for handling the material to and from them have been grouped, and the groups are driven from separate line shafts in the south bay. A few of these machines have special foundations, but as this bay has a floor underlaid with concrete, it is deemed sufficient for the majority of the tools. In the second bay are located the heavier tools, which require crane service for the material upon which they work. The majority of these, some 25 in number, have individual motors with a 4 to 1 speed variation, supplemented in some cases by gear changes when an additional range is necessary. There is no machinery in the central bay or erecting shop, except a 17-ft. gap riveter, located at one end in a pit and served by a special 20-ton crane located in the roof framing above the larger crane runway. The majority of the tools in the fourth bay are hydraulic tools for the boiler shop. A departure from general practice has been made in equipping the boiler shop, as hydraulic power has been applied to nearly all of the punching, shearing, flanging and riveting machines.

The north bay will be devoted to belt-driven boiler-shop tools at one end; there being no cranes to cover this last bay. It is stated that about 66% of the boiler shop, 100% of the erecting shop and 50% of the machine shop area will have crane service, and in some bays a number of cranes will be operated in order to cover the necessities. A list of the traveling cranes has already been given.

The space in the boiler shop will also be used for various purposes, including a department for cutting bolts and stay bolts. Considerable room has been assigned for flue work, and the flues will be cleaned by a Westmark submerged flue rattler, this being considered superior to the dry rattler process. Farther along in this department will be located machinery for the copper, tin and sheet-iron tank work, tender truck and brass work, pipe work, etc., and at the extreme end of the shop will be located a few wood-working tools for general use.

BLACKSMITH SHOP TOOLS.—The blacksmith shop machinery is new to a considerable extent; consisting of steam hammers, forging and boiler machinery, punches, shears, etc. The steam hammer will be served by jib cranes, and there will be a large number of oil furnaces of the Ferguson type, made by the Railway Materials Co. One end of the blacksmith shop building will be devoted to the purpose of a brass foundry, although no arrangements as yet have been made for transferring the company's brass foundry, which is now in operation at the Chicago shops.

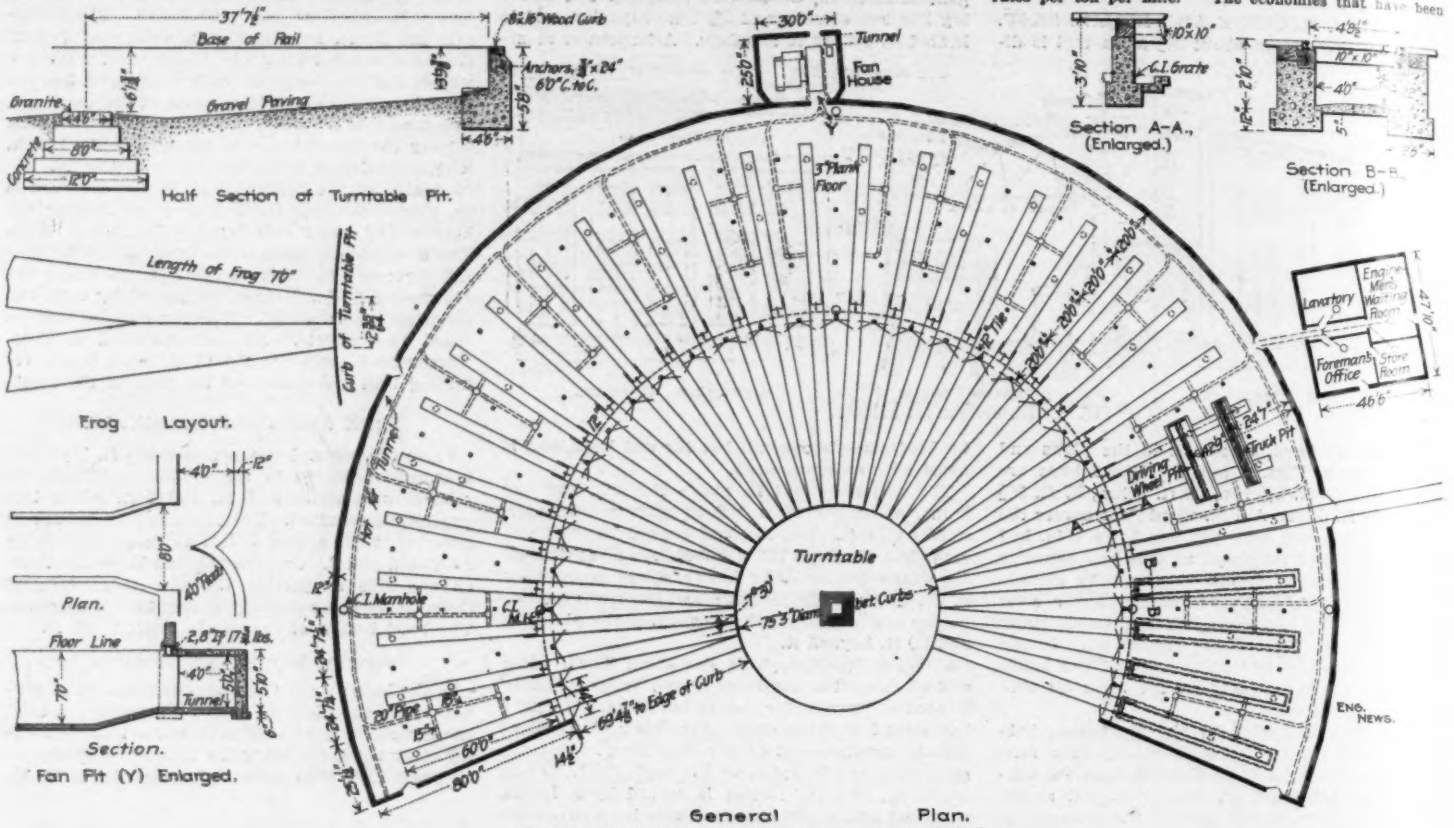


FIG. 8. PLAN AND DETAILS OF ROUND HOUSE.

PRESENT DAY COSTS OF TRANSPORTATION BY RAIL AND BY WATER.*

By K. W. Blackwell,† M. Can. Soc. C. E.

A majority of the members of this society in the ordinary routine of their professional duties have been engaged on work which is more or less connected with the great problem of transportation. I presume, therefore, that I need not apologize when I ask them to follow me for a brief space while I endeavor to point out the general commercial result of their labors, as expressed in rates per ton per mile. The economies that have been brought about in transportation on this continent are so much in advance of what has been done in England, and Enrope generally, that I have confined my remarks to the ton-mileage results on this continent, and in the American Atlantic trade.

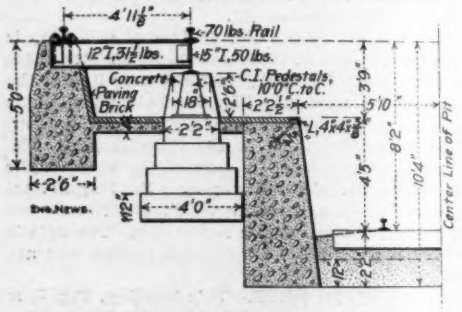


Fig. 10. Section of Cinder Pit.

TABLE I.—Freight Rates, 1903.

		Rate.	Haul in miles.	Rate pr ton pr mile in cts.
All Rail Rates.				
Chicago to Portland	Grain.*	$0.16	1,138	0.31
Chicago to New York	"	.16	971	.37
Brandon to St. John, N.B.	"	.35	2,038	.37
Spring Hill, N.S., to Montreal	Coal.†	1.80	738	.25
Lake and Rail Rates.				
Chicago to Montreal	Grain.*	$0.13	1,080	.26
Brandon to St. John, N.B.	"	.25	2,038	.22
Chicago to Montreal.‡	"	.08	827	.21
Inland Water Rates.				
Duluth to Cleveland	Iron ore.	.80	875	.09
Chicago to New York	Grain.*‡	.09	1,330	.15
Chicago to Montreal	Grain.*	.12	1,175	.23
Duluth to Quebec	"	.12	1,580	.17
Ocean Rates.				
Montreal to Antwerp	Grain per Qr.	£0 1 3	3,250	.044
Antwerp to Montreal	St'l rails pr ton	0 7 3	3,250	.053
Montreal to Liverpool	Grain per Qr.	0 1 3	2,900	.046

*Per 100 lbs.
†Per ton.
*‡Via Erie Canal, per 100 lbs.
‡Via Canada Atlantic.

The engineer who is interested in works that have brought about such gratifying results commercially, is now invited to look at the accompanying table of freight rates reduced to a ton-mile basis (Table I.). In putting forward these rates, no effort was made to search for

*Presidential address before the Canadian Society of Civil Engineers at Montreal, P. Q., Jan. 28, 1904.

†856 Sherbrooke St., Montreal.

isolated cases of unusually low rates, but rather to furnish an idea of what regular every-day freight rates actually are. They are not, of course, the average rates which apply on miscellaneous articles, but are the low long-haul rates which obtain to-day in the handling of grain, coal, iron, etc., which constitute the greatest part of our tonnage. These splendid results from an economical point of view are what you are invited to consider.

Let us analyze the details of the water carriage of iron ore from Duluth to Cleveland, O. The particulars of a standard ore-carrying lake steamer are as follows: Length, 416 ft. keel; over all, 436 ft.; 50-ft. beam; 28-ft. depth molded; carrying capacity, 6,500 gross tons of iron ore; consumption of coal on round trip of 875 miles (going up light and returning with ore), 180 tons; approximate value of boat, $280,000. The engines of this boat are of the vertical type with three inverted cylinders 22, 35, and 58 ins. by 42-in. stroke, indicating 1,300 HP., which propel the boat 11 miles per hour. Cost per day for wages, about $70. This steamer can be loaded from the ore pockets in 50 mins., and unloaded by mechanical means in 6 or 7 hrs.

You will observe that this ore business is done at .09 of a cent per ton per mile at present, when rates are supposed to be very remunerative. And it is a well-known fact that these vessels have made profitable returns on a 60 cts. rate, which is .06 of a cent per ton per mile, or in round numbers less than one-tenth of the average rate of freight per ton per mile that is earned by the railways of this continent.

It may be interesting to you to know, because it confirms these figures, that the Dominion Coal Co. find by their large experience in the transportation of coal, of say about 1,000,000 tons per annum, from Sydney to Montreal, that the actual cost of transportation owning or chartering their own vessels is 55 cts. per ton, for the distance of 780 miles or say about .06 cent per ton per mile.

The history of the competition between the Erie Canal and the railways paralleling it is most instructive in connection with this question of cost of carriage per ton per mile. The present old-fashioned canal boats have a capacity of 240 tons, and the grain rate this summer from Buffalo to New York by canal was 2.6 cts. per bushel, or 0.23 ct. per ton per mile, and while it is a fact that the parallel roads were charging nearly 4 cts. per bushel, or say 35 cts. per ton per mile for the same haul, the canal is now more or less out of business, and many of the boats laid up. This state of affairs has been brought about by the railways, which on more than one occasion during the last few years made a cut on the grain rate from Buffalo to New York, to 2.5 cts. per bushel, which so disturbed canal traffic as to leave the railways the masters of the situation. The taxpayers of the State of New York have now decided to spend $101,000,000 in enlarging the Erie Canal, giving it a depth of 12-ft. so that 1,000-ton barges can be used, and the rates reduced to .06 of a cent per ton mile, or less than ¾-ct. per bushel, Buffalo to New York. The New York State Canal Committee, after a careful inquiry into this matter, reported that there was no probability of the railways ever being able to carry freight at 0.1 of a cent per ton per mile, which would be a guarantee of the continued and uninterrupted value and usefulness of the canal to the state.

I think you will agree with me that the estimate these commissioners made was a pretty safe one, and that the figures have a most important significance with reference to the whole question of the relative cost of land and water transportation.

These examples of water rates are sufficiently low to be eminently satisfactory, and while they may be undoubtedly somewhat improved upon in the future, they leave very little to be desired, considering all the circumstances.

The exhibit given in the table of rates on the Atlantic shows still lower rates per ton per mile, but it is generally conceded by shipping men that these rates are more or less unprofitable and are about rock bottom.

While shipping men are not holding out hopes of any substantial reduction in rates in the near future, railway men on the other hand appear to be alive to the possibility of further economies.

The present comparatively low railway freight rates have come from many causes, larger locomotives, larger cars, and the practice of making up train loads to the full capacity of each locomotive, and also to that most important work of improving the grades and curvature. This last question is one to which all railway officers are now fully aroused. It is with them the most important question of the hour. Nearly every railway company in good standing financially is making marked progress in this respect. The railway president to-day who has mapped out a plan of improvement for his road that will result in a reduction of controlling grades of say from 1 to 0.4% has, so to speak, a "level head." Such a change will reduce the cost of hauling freight per ton per mile very largely, and he will be able to give to the community served by his road lower rates and at the same time place the railway in a better position to give its shareholders fair returns on their investments.

A very brief examination of the subject of engine loads upon varying grades affords the most convincing proof of the value of easy grades. Mr. A. M. Wellington, in his work on the economic theory of railway location, gives the following figures to show what is a working load of a locomotive upon various grades. For instance he sets forth in his tables that an 18 × 24-in. freight engine could haul, on varying grades, the loads given in the first column of the accompanying Table II.

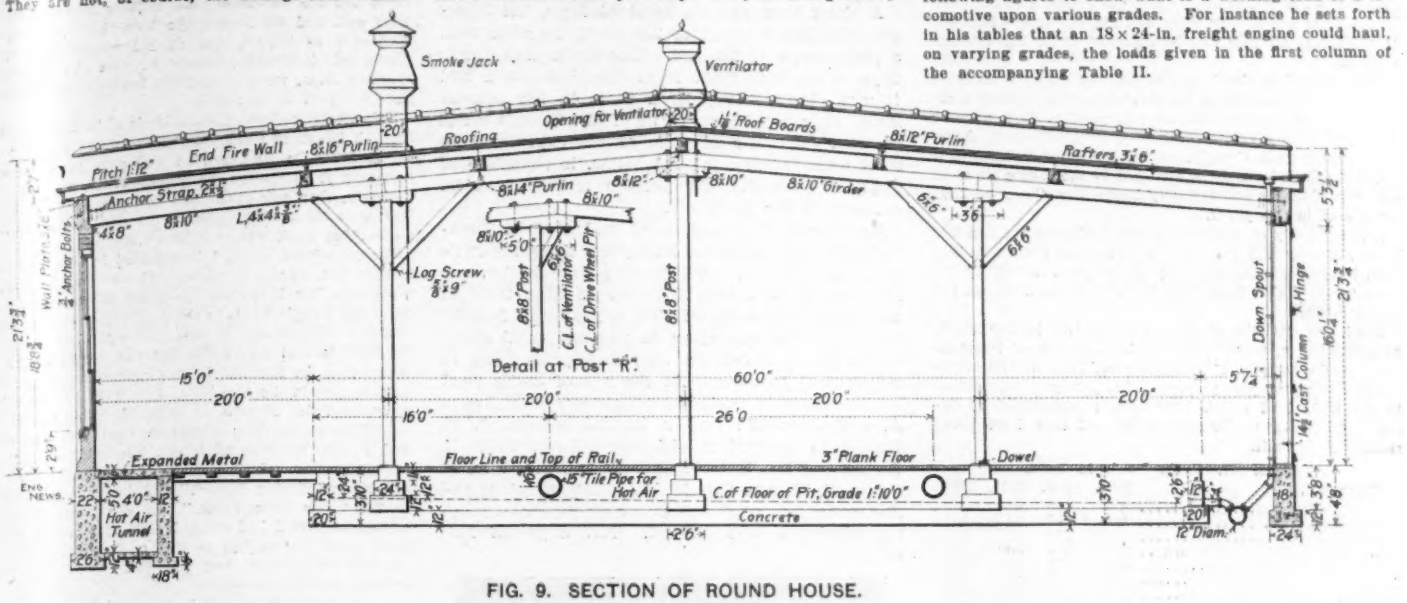


FIG. 9. SECTION OF ROUND HOUSE.

TABLE II.—Load Rating for 18 × 24-in. Locomotive, in Net Tons including Weight of Cars.

Gradient.	Total load in net tons. Mr. Wellington's table.	Total load in net tons. Can. Pacific R. R. ratings.	Gradient.	Total load in net tons. Mr. Wellington's table.	Total load in net tons. Can. Pacific R. R. ratings.
Level. ...	2,183	.....	0.6% ...	883	1,000
0.1% ...	1,733	1,500	0.7% ...	751	900
0.2% ...	1,433	1,400	0.8% ...	682	800
0.3% ...	1,219	1,300	0.9% ...	625	700
0.4% ...	1,058	1,200	1.0% ...	578	607
0.5% ...	933	1,100			

I have examined the working ratings and loads for locomotives as adopted by the Canadian Pacific Railway, after they had arrived at the same by making an exhaustive investigation of the subject by aid of a dynamometer car, and find that they work out approximately as shown in the second column of Table II. This is an interesting and satisfactory comparison.

In explanation of the discrepancies in the above table, it must be remembered that a level piece of road free from the complications of curvature is very rare, and Mr. Wellington's figures giving the load for a level piece of road as 2,183 tons were no doubt arrived at after making a test on an ideal piece of level tangent, which is hard to find in actual practice. The question also of speed has to be considered very carefully in making a comparison of this nature.

With regard to possible further reduction in rail rates in the future, I have analyzed the result of some of the most economically operated railroads on this continent, as shown in "Poor's Manual." The public of this country are paying on an average, as before stated, about 0.70 ct. per ton per mile for their freight rates by rail, but at the same time a large amount of mineral and grain traffic is handled, as shown in this paper, below 0.35 ct. per ton per mile. In fact that remarkably well equipped railway, namely the Bessemer & Lake Erie, which handles most of the iron ore coming from the Great Lakes to Pittsburg is able to show very good returns on its capital and make extensive betterments to its system at the same time, on an average rate of 0.4 ct. per ton per mile.

The tonnage statistics as published in the annual report of this road are of great interest, and having one of the heaviest mineral traffics in the world, it has conditions for making a good showing which are quite ideal; for instance its average load of freight for last year on southbound iron ore trains was 1,479 tons, and its average train

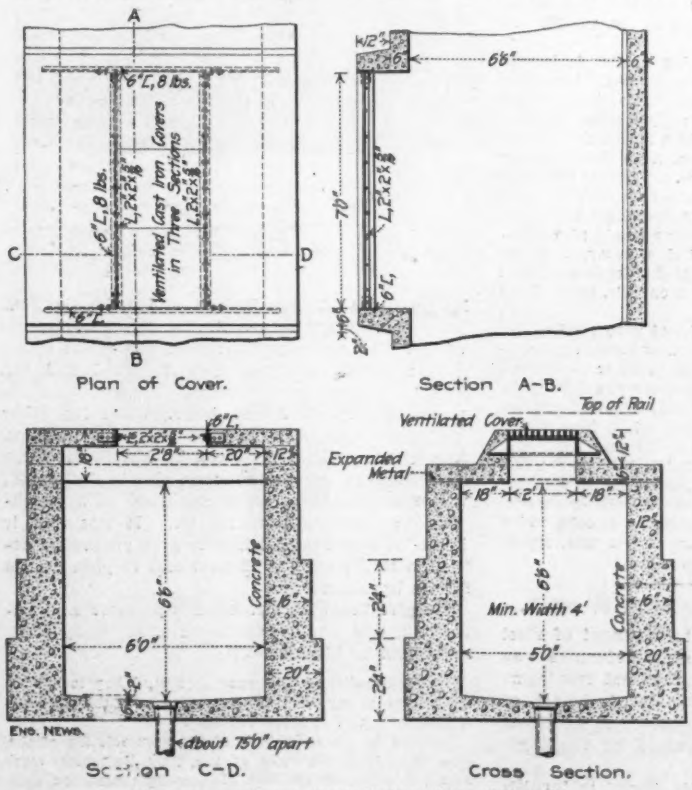


FIG. 11. TUNNEL FOR PIPES AND CABLES.

load for north and south bound trains was 913 tons. These are remarkable figures and are more than 100% better than are shown by such roads as the transcontinental systems, all of which handle a mixed traffic, and the train load results which they show of from 300 to 480 tons per train-mile is all that can be expected under the circumstances.

With regard to the future of railway rates, a study of the subject forces one to the conclusion that railway companies are so progressive and enterprising, that, given a large and steady volume of traffic, they will equip themselves to carry it cheaply, as the Bessemer & Lake Erie Ry. and others have done, and that in the future we shall see rates that are substantially lower than those we have considered in this paper.

It is generally conceded that the rapid progress that has been made by the railways in operating economies has been largely brought about up to the present time by the improvements that have been made in locomotive and car construction.

The latest statistics obtainable on the trainload question, as given below, would indicate that the rate of improvement in the train load figures has not been so well maintained during the past year, and that yearly improvements in the train load which have been accomplished by increasing the size of the locomotives and cars, have about reached their limit.

TABLE III.—Train Loads in Tons.

Increased.	1903.	1902.	1901.	1900.
Lehigh Valley	485	466	463	429
Atchison	279	247	242	221
Illinois Central	288	274	235	221
New York, Ontario & Western	287	285	290	287
Norfolk & Western	486	476	461	345
C., C., C. & St. Louis	333	332	333	335
St. Louis & San Francisco	195	186	200	154
Wabash	302	285	283	269
Toledo, St. Louis & Western	295	285	250	...
Wisconsin Central	303	286	200	258
Erie	406	376	375	369
St. Louis South Western	252	232	210	207
Unchanged.				
New York, New Haven & Hartf'd	218	218	208	204
Louisville	231	231	222	239
Decreased.				
Northern Pacific	344	346	324	317
St. Paul	244	254	237	205
Southern	193	195	192	176
Chesapeake & Ohio	493	509	511	488
Chicago & Great Western	277	291	313	261
Chicago & New Orleans	231	249	232	235

In order to make further reductions the railways must continue the work of cutting down their grades, and will also probably obtain additional economy from the adoption of the alternating current electric locomotive.

The question of coal consumption in relation to ton-mileage is also of interest. In large freight vessels fitted with marine engines of the most advanced type for fuel saving, a consumption of 2.5 lbs. of coal per 100 ton-miles of freight carried, has been claimed as a record, but marine engineers generally regard a consumption of 5 lbs. of coal per 100 ton-miles as the average; whereas the consumption of coal upon railways is about 19 lbs. per 100 ton-miles.

I commenced my early engineering training in locomotive work, and have the highest appreciation of the locomotive in all the stages of its wonderful development. But it would seem that it has now nearly reached its limit, and is destined to be out-classed by a machine which will merely consist of a group of four or more electric motors mounted on as many driving axles. There is no doubt that such electric apparatus has been designed and can be built upon the basis of electrical engineering science as it now exists, and that such a machine would give better results than the locomotive in fuel economy, draw-bar pull, and the economical and elastic distribution of wheel load with reference to wear and tear on rails, roadbed and bridges.

There are no data in existence, based upon results, that can lead us to any definite conclusion as to what the relative consumption of fuel and power would be as between the handling of freight trains as they are now handled by steam locomotives, and the results that might be obtained by the use of the electric locomotive driven from a central power station. Still, we have the very instructive and significant comparison which exists between the fuel consumption on steam tram cars as compared with the consumption on electric cars in street railway service. In the case of the former, the consumption of coke, which is the usual fuel used, is 15 lbs. per car per mile, and in the latter 8 lbs. of coal per car per mile.

A PIONEER IN THE HEAT TREATMENT OF STEEL.

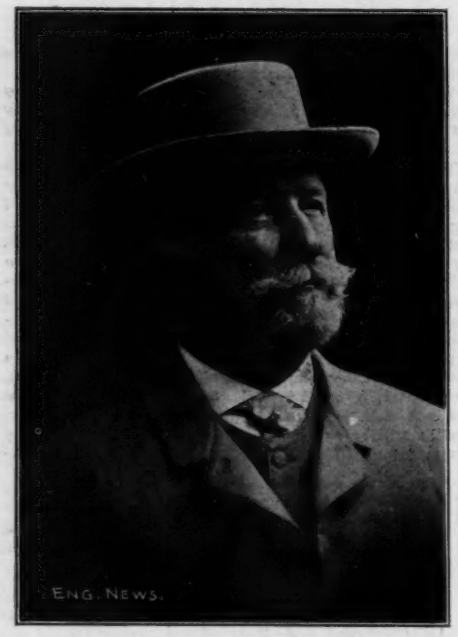
In an editorial on the heat treatment of steel in our issue of Oct. 8 last, some reference was made to the pioneer work in the heat treatment of steel which was done by Mr. W. A. Sweet, of Syracuse, N. Y., and the importance of which at the time was wholly unrecognized by the engineering profession.

At that time we requested Mr. Sweet to furnish us some account of his early work in this field for publication in Engineering News. In his reply, dated Oct. 13, Mr. Sweet said:

I thank you for your notice of my efforts. My brother, Prof. John E. Sweet, will aid me in giving you some of my early history soon. I am an old man, 73 yesterday, and have been sick for 18 months, but am gaining slowly.

A short time ago we received from Mr. Sweet the promised account of his work, together with a photograph of himself. The letter was put in type, a cut was made from the photograph and it was planned to publish them in the present issue, when word reached us of Mr. Sweet's death on Jan. 30. His account of his experience in steel manufacture, printed below, is therefore of peculiar interest. We preface it with a brief account of his early life.

Mr. Sweet was born, lived and died in Onondaga county, N. Y., his birthplace being the little town of Pompey. When 18 years old he was apprenticed to a manufacturer of edge tools at the munificent wage of "$40 a year and found." His early life was spent in various small shops where he acquired an all-round proficiency in mechanical pursuits. At the age of 38 he went into partnership with two of his brothers, Anson A. and John E., and a brother-in-law, C. C. Bates, as general machinists. Later John E. Sweet and Mr. Bates withdrew and Mr. Wm. B. Cogswell, M. Am. Soc. M. E., took their place and the manufacture of knives for mowing and reaping machines was started. Mr. Cogswell sold



W. A. Sweet.

his interest to George Barnes, and under the firm name of Sweet, Barnes & Co., the manufacture of tool steel and merchant steel was taken up.

This partnership was also dissolved and Mr. Sweet continued in steel manufacturing under the name of Wm. A. Sweet & Co., while the other partners continued the edge tool manufacture. Among the articles produced by Mr. Sweet were steel sections for wagon tires, sleigh shoes, etc., where resistance to wear combined with toughness was an important matter. It was this, it is likely, that first led him to give particular attention to the quality of steel and to plan means for its improvement.

We give herewith Mr. Sweet's portrait and autograph, and print his account of his early work as written by himself:

Sir: In compliance with your request, I beg to submit the history of my work in connection with the finishing of Bessemer steel at a low red heat.

Knowing in the early '60's of the accumulation of the crop ends from the rails at the Troy Bessemer steel works, I conceived the idea of splitting these crop ends in three parts and rolling or hammering the parts into bar stock. With a very little experimenting, I succeeded in doing this. The scheme not only proved practical but profitable and we were not only able to use up the entire product of crop ends from the Troy mill but that of all others that we could obtain where the pieces were not less than a foot long. The rolling mills after a while began to gage these ingots better, so there were fewer crop ends, but the Bessemer steel rails in England began to wear out, and we bought the English rails which were sent over as ballast, and after breaking them in four pieces (which were the longest we were able to heat) and splitting them, we continued the business notwithstanding the falling off in crop ends.

This working of the various kinds of both American and English Bessemer stock showed that there was a wonderful variation in its character and gave me a better opportunity to determine the quality of the various makes, probably, than any other man in the country. We found that some stock when rolled to the small sizes was tough, while other stock was very brittle.

The experience which I had gained in edge tool manufacture had taught me that steel was tougher when finished at a low heat than when left to cool from a high heat, and I applied this to the finishing of our stock at an immense advantage. It cost nothing in delay to allow the steel to cool before the last two passes in the rolls, except that the first bar did not come through so soon.

Some time in the late '70's, Vanderbilt bought quite an extensive order of rails in England. This caused widespread comment from American steel men and editors, and I took occasion to defend Vanderbilt's action in a communication, which after being rejected by the "Engineering and Mining Journal" and the "Iron Age" appeared in the "New York Times." In this paper I made the statement that I had worked steel from every Bessemer steel plant in America, as well as the English, and that the English made the best rails and hence that Vanderbilt was justified in his action.

In my statement that I had worked all kinds of American steel, I was in error, as I had never had any from the Edgar Thompson Works. This caused the late Capt. W. R. Jones to read a paper before the American Institute of Mining Engineers at its Pittsburg meeting in 1879 ridiculing the idea that the English rails were any better than those made at the Edgar Thompson Works or that there was any merit in the finishing at a low heat.

The late A. L. Holley attempted to confirm Mr. Jones by saying that the English made 50% more rails in a day than we did and hence the rails must be finished at a higher heat. As a matter of fact, the English were, according to his own statement, rolling rails double length and therefore if they only made 50% more, the billet must have been 33% longer time in the rolls.

At this same Pittsburg meeting, I had taken with me two ingots of tool steel, both split from end to end, one to show to what extent the pipe extended and the other showing a method of preventing it. I may say, by way of parenthesis, that this was done by covering the top of the freshly poured ingot with red hot charcoal, and it may interest some of your readers to know, that pulverized charcoal can be heated red hot in a ladle and poured like melted lead.

I also showed samples of steel cut from the same bar with one piece left at high heat and the other low red when finished. The one left at high heat could be broken easily with a machinist's hammer and broke short off, while the other doubled over cold.

Astonishing and convincing as these samples were, they attracted no attention from the steel men, and being called upon for a reply I simply said I would reply to Mr. Jones at the next meeting. I called on the secretary for a copy of Mr. Jones' paper, but never could get it, and that part of Mr. Jones' paper which referred to me and my work was stricken from the "Transactions," by the publication committee, and I was in this way prevented from making reply.

The facts are that I had discovered that the finishing of Bessemer steel at a low heat greatly improved its quality as far back as somewhere in the '70's; that it has been the universal practice at the works of which I have had control from that day to this; that the bars have always been allowed to cool before the last passes, when they were of such size and temperature as made it necessary; and that I pointed out to the rail makers that this would not restrict the output.

Long before this, in the time of the rebellion, I experimented with the heat treatment of tool steel ingots and found that I could refine the steel just the same by the proper treatment, as is done by hammering, and increase the tensile strength the same. I sent a treated ingot to the navy department at Washington and endeavored to furnish steel guns in the place of cast iron then in use, but although the specimen I sent stood a tensile test of 110,000 lbs. per sq. in., I failed in getting a contract. This was nearly forty years ago, and before much had been done in steel guns.

If the American rail makers had entered into a thorough investigation with a view of demonstrating the truth or falsity of the statements set forth in the "New York Times," and which was fully illustrated by samples exhibited at Pittsburg, the rails made by them would have been vastly improved in quality without materially increasing the cost; the life of the rails would have been longer by a very considerable percentage; and the saving to the railroads of the country would have amounted to hundreds of millions of dollars.